
Librum hunc cui titulus

The ANATOMY of *Humane* Bodies,

Dignum censemus qui Imprimatur.

Daniel Whistler, M. D. and President
of the King's College of Physicians, *London*.

Tho. Witherley, Elector and Censor.

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THE
ANATOMY
OF
HUMANE BODIES
EPITOMIZED.

WHEREIN

All the PARTS of Man's Body; with their
ACTIONS and USES, are succinctly
described, according to the newest
doctrine of the most accurate and learned
Modern Anatomists.

*The Second Edition, Corrected and Enlarged
both in the Discourse and Figures.*

By *Tho. Gibson*, M. D. and Fellow of the Col-
lege of Physicians, *London*.

L O N D O N, *8^o L. 70. Med.*

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ANATOMY

HUMAN BODIES

EXPLAINED



TO THE
READER.

I*F any be surpriz'd by the Novelty of having a name subscrib'd to the title of this second Edition which was conceal'd in the first, let him know, that 'tis done with no design either to gain reputation to the Author by any fancied worth in the Book, or to procure any value for the Book, by signifying it to be the work of such an Author: for he has neither the fondness to have such an opinion of his Book, nor the vanity to have it of himself. But the true reason is, the unfaithfulness of either the Printer or Bookseller, who (though injoin'd secrecy) have made the Author's name more generally known than himself; so that 'tis rather become a piece of modesty to own and confess what so many know, than any confidence, to publish that which it were to no purpose any longer to dissemble.*

As to the Occasion of writing this Treatise, that was intimated in the former Impression, viz. the Bookseller's recommending to me the perusal and correction of Dr. Alexander Read's Manual of Anatomy; in doing which I found it necessary to blot out, alter, and add so many

To the Reader.

things, that the work became, by much, more mine than his : But of this second Impression it may truly be said what is reported of the ship wherein Jason, &c. fetcht away the golden fleece, That it is so much repaired, that hardly one stick of the first materials remains. So that it had been but small injustice, altogether to have conceal'd Dr. Read's name, who is now intitled to so inconsiderable a share.

As to the Book it self, it offers it self the more boldly to publick view, because it comes abroad recommended by the most learned President, and the worthy Censors of our College, whose Imprimatur may justly bespeak it a kind entertainment. It speaks English indeed ; but so, that none shall well understand it, that is a stranger to the more learned Languages : and therefore it disdains the conversation of Quacks and old Women, leaving them to meditate on the traditional virtues of their Receipts, without offering to instruct them in the knowledge of themselves, of which their ignorance and impudence render them incapable in any sense.

Its ornaments indeed are in a great measure borrow'd, but it fears not the fate of the Daw in the Fable, to be unplum'd and laught at, because they are not furtivi colores, seeing it struts not in them as its own, but has every where the ingenuity to confess the true Owners. Whom if the Reader desire to know, it here presents him with a list of the principal.

Adrian.

To the Reader.

Adrian. Spigelius *de humani corporis fabrica.*
Isbrandi de Diemberbroeck *Anatome corporis humani.*

Thomæ Bartholini *Anatome.*

* Dr. Highmore's *Corp. hum. disq. Anatomica.*

Dr. Willis *de Cerebro.*

* — *de sanguinis Incalescentia sive Accensione*
Exercitatio Medico-physica.

— *de primis viis, & de respirationis organis,*
in the first and second part of his Pharma-
centice Rationalis.

Dr. Lower's *Tractatus de Corde.*

Dr. Glisson's *tractatus de Ventriculo & Inte-*
stinis.

— *Anatomia Hepatis.*

Dr. Charlton's *Enquiries into humane Nature*
in IV. Anatomick Prelections in the New
Theatre of the Royal College of Physicians in
London.

Dr. Harvey's *Exercitationes Anatomicae de*
Cordis motu & circulatione Sanguinis.

— *Exercitationes de generatione Animalium.*

* Francisci Stockhamer, *Doctoris Medici &*
Anatomici Microcosmographia.

* Laurentii Bellini *Exercitatio Anatomica de*
structura & usu Renum.

* Casp. Bartholini *Thom. F. Diaphragmatis*
structura nova.

Malpighius *de Viscerum structura.*

— *Exercitationes Epistolicae de Cerebro, Lin-*
gua, &c.

Dr. Grew's *Comparative Anatomy of Stomachs*

To the Reader.

and Guts; subjoined to his *Museum Regalis Societatis*.

* Joh. Conradi Peyer's *Exercitatio Anatomico-Medica de glandulis Intestinalium*.

* Joh. Conradi Brunner's *Experimenta nova circa Pancreas*.

* Dr. Mayow's *Tractatus quinq; Medico-physici, &c.*

Regneri de Graef *Opera omnia*.

Johannis Swammerdami *Miraculum Naturæ, sive Uteri Muliebris fabrica*.

Dr. Walter Nedham's *disquisitio Anatomica de formato Fœtu*.

Dr. Briggs's *Ophthalmographia, sive Oculi ejusque partium descriptio Anatomica*.

* Mons. du Verney of the Ears.

Dr. Crone de *ratione Motus Musculorum*.

* Dr. Henshaw's *Aero-Chalinos*.

Dr. Wharton's *Adenographia, sive Glandularum totius Corporis descriptio*.

* Nicolai Stenonis de *glandulis Oris, & novis earundem vasis Observationes Anatomicae*.

* — De *Musculis, & glandulis Observationum specimen*.

* Dr. Cole's *Cogitata de secretionibus Animalium*.

These, I say, are the principal Authors which have adorned this Book; several whereof were not sought to in the former Edition, (which for distinction are marked with an Asterisk) and those that were, have now been much more liberal

To the Reader.

liberal in contributing their symbols to make it more compleat.

As it is, if it may assist the memory of such as are well skill'd in Anatomy, or instruct and direct the young Beginner, I have not miss'd of my design.

Farewell.

ERRATA

PAge 486. for *costa* read *spine*. p. 495. l. 24. dele or *costa*. p. 496. l. 3. for *costa* r. *spine*. *ibid*. l. 15, 16. dele or *costa*.

These are my mistakes: as for those of the Printer, I hope they are so inconsiderable, as not to be worth the noting.

THE CONTENTS.

Of the lowest Cavity called *Abdomen*.

Book I.

C HAP. I. Of the division of the parts of the Body of Man in general.	Page 1
II. Of the circumscription, regions and parts of the Abdomen.	7
III. Of the common containing parts of the Belly.	10
IV. Of the proper containing parts.	18
V. Of the Omentum.	21
VI. Of the Gula.	29
VII. Of the Ventriculus or Stomach.	33
VIII. Of the Intestines or Guts.	43
IX. Of the Mesentery.	57
X. Of the Venæ lacteæ, Glandulæ lumbaræ, Re- ceptaculum chyli, Ductus chyliferus thoraci- cus, and of the motion of the Chyle.	62
XI. Of the Liver.	68
XII. Of the Vena portæ.	76
XIII. Of the Vena cava dispersed within the Abdo- men.	83
XIV. Of the Gall-bladder and Porus bilarius.	87
XV. Of the Pancreas.	94
XVI. Of the Spleen.	99
XVII. Of the Kidneys and the Glandulæ renales.	110
XVIII. Of the Ureters.	123
XIX. Of	

The Contents.

XIX. Of the Bladder.	125
XX. Of the Vasa præparantia in Men.	129
XXI. Of the Stones or Testicles, and the Epididymidæ.	132
XXII. Of the Vasa deferentia, Vesiculæ seminales and Prostata.	141
XXIII. Of the Yard.	147
XXIV. Of the Vasa præparantia in Women.	157
XXV. Of Womens Testicles or Ovaria.	159
XXVI. Of the Vasa deferentia in Women, or their Oviducts.	163
XXVII. Of the Uterus or Womb, and its Neck.	168
XXVIII. Of the Vagina and its Contents, viz. the Hymen, and Carunculæ myrtiformes.	175
XXIX. Of the Pudendum muliebre or Woman's Privy.	180
XXX. Of a Conception.	187
XXXI. Of the Placenta uterina or Womb-liver, and Acetabula.	198
XXXII. Of the Membranes involving the Foetus, and of the humours contained in them.	202
XXXIII. Of the Umbilical vessels, and of the nourishing of the Foetus.	208
XXXIV. What parts of a Foetus in the Womb differ from those of an adult person.	222
XXXV. Of the Birth,	226

Book II.

Of the middle Cavity called *Thorax*.

CHAP. I. Of the common containing parts of the Breast.	Page 231
II. Of the proper containing parts; and first, of the Dugs.	232
III. Of	

The Contents.

III. Of the internal proper containing parts.	245
IV. Of the Pericardium, and the humour contained in it.	257
V. Of the Heart, in general, and of the reason of its motion.	260
VI. Of the Pulse, and the circulation of the Blood.	267
VII. How Blood is made of Chyle, of its Heat and Colour, and whether the Body be nourished by it.	274
VIII. Of the parts of the Heart, viz. the Auriculæ, the Ventricles, and the Septum that divideth them.	284
IX. Of the Ascending trunk of Vena cava.	287
X. Of Vena arteriosa, and Arteria venosa.	296
XI. Of the Aorta, or great Artery.	269
XII. Of the Aspera Arteria and Lungs.	314
XIII. Of Respiration.	323
XIV. Of the Neck and the parts contained in it, viz. the Larynx, Pharynx, Tonsillæ, &c.	331

Book III.

Of the highest Cavity, or Head.

CHAP. I. Of the Head in general, and its common containing parts.	Page 337
II. Of the Hair.	339
III. Of the proper containing parts.	342
IV. Of the Brain in general.	348
V. Of the manner of dissecting the Brain, of the Brain properly so called; the Fornix, Septum and the three Ventricles.	350
VI. Of the Medulla oblongata and its fore parts, viz.	

The Contents.

<i>viz.</i> Crura, Corpora striata, Nervorum opti- corum thalami, Nates, and Testes; as also of the Glandula pinealis, Plexus choroides, and Infundibulum.	354
VII. Of the Cerebellum, and the fourth Ventricle; as also of the hinder part of the Medulla oblon- gata, of the Rete mirabile and Glandula pitui- taria.	359
VIII. Of the Spinalis medulla.	366
IX. Of the Action of the Brain, and the (supposed) Succus nutritius of the Nerves.	368
X. Of the Nerves arising within the Skull, and first of the first and second pair.	374
XI. Of the third and fourth pair.	378
XII. Of the fifth, sixth and seventh pair.	381
XIII. Of the eighth, ninth and tenth pair.	384
XIV. Of the Nerves of the Spinalis medulla; and first of the Nerves of the Neck.	394
XV. Of the Nerves of the Vertebrae of the Thorax.	398
XVI. Of the Nerves of the Vertebrae of the Loins.	400
XVII. Of the Nerves which arise from the marrow of Os sacrum.	402
XVIII. Of the Face and its parts.	405
XIX. Of the Eyes in general, and their outward or containing parts.	407
XX. Of the Tunicles of the Eye.	411
XXI. Of the humours and vessels of the Eye.	413
XXII. Of the Auricula.	416
XXIII. Of the inward part of the Ear.	418
XXIV. Of the Nose.	425
XXV. Of the external parts of the Mouth.	428
XXVI. Of the inner parts of the Mouth.	429

The Contents.

Book IV.

Containing a description of the Veins,
Arteries and Nerves of the Limbs.

C H A P. I. Of the Veins of the Arm.	Page 437
II. Of the Arteries of the Arm.	439
III. Of the Nerves of the Arm.	440
IV. Of the Veins of the Thigh, Leg and Foot.	441
V. Of the Arteries of the Thigh, Leg and Foot.	ibid.
VI. Of the Nerves of the Thigh, Leg and Foot.	442

Book V.

Containing a Treatise of all the Muscles of
the Body.

C H A P. I. Of a Muscle in general, and of its parts.	Page 445
II. Of the differences and actions of the Mus- cles.	451
III. Of the Muscles of the Eye-lids and Forehead.	454
IV. Of the Muscles of the Eyes.	456
V. Of the Muscles of the Nose.	459
VI. Of the Muscles of the Lips and Cheeks.	461
VII. Of the Muscles of the lower Jaw.	464
VIII. Of the Muscles of the Ear.	467
IX. Of the Muscles of the Tongue.	470
X. Of the Muscles of the Bone of the Tongue, called Os hyoides.	471
XI. Of	

The Contents.

XI. Of the Muscles of the Larynx.	473
XII. Of the Muscles of the Uvula, Palate and Throat.	476
XIII. Of the Muscles of the Head.	477
XIV. Of the Muscles of the Neck.	480
XV. Of the Muscles of the Thorax.	481
XVI. Of the Muscles of the Back and Loins.	484
XVII. Of the Muscles of the Abdomen.	486
XVIII. Of the Muscles of the Genitals, both in Men and Women.	490
XIX. Of the Muscles of the Bladder and Anus.	491
XX. Of the Muscles of the Scapula or Shoulder-blade.	492
XXI. Of the Muscles of the Arm.	494
XXII. Of the Muscles of the Ulna.	498
XXIII. Of the Muscles of the Radius.	500
XXIV. Of the Muscles of the Wrist.	501
XXV. Of the Muscles of the Palm of the Hand.	503
XXVI. Of the Muscles of the four Fingers.	504
XXVII. Of the Muscles of the Thumb.	508
XXVIII. Of the Muscles of the Thigh.	510
XXIX. Of the Muscles of the Leg.	513
XXX. Of the Muscles of the Foot or Tarsus.	516
XXXI. Of the Muscles of the Toes.	519

Book VI.

Of the Bones.

CHAP. I. Of Bones in general.	Page 515
II. Of the different conjunction of Bones one to another.	528
III. Of the Skull in general.	530
IV. Of the Sutures of the Skull.	532
V. Of	

The Contents.

V. Of the proper Bones of the Skull.	535
VI. Of the Bones common to the Skull and upper Jaw.	539
VII. Of the upper and lower Jaws.	541
VIII. Of the Teeth.	544
IX. Of the Bone of the Tongue called Os hyoides.	548
X. Of the Bones of the Neck, viz. the Claviculae and Vertebrae.	549
XI. Of the Vertebrae of the Thorax.	552
XII. Of the Ribs.	554
XIII. Of the Breast-bone or Sternum.	556
XIV. Of the Vertebrae of the Loins.	557
XV. Of the Os sacrum, and Os coccygis or Rump-bone.	558
XVI. Of the Hip-bone.	560
XVII. Of the Scapula or Shoulder-blade.	562
XVIII. Of the Os humeri or Shoulder-bone.	564
XIX. Of the Bones of the Cubit.	565
XX. Of the Bones of the Hand.	567
XXI. Of the Thigh-bone, and Patella.	569
XXII. Of the Bones of the Leg.	571
XXIII. Of the Bones of the Tarsus.	573
XXIV. Of the rest of the Bones of the Foot.	576

An Appendix to Book VI.

CHAP. I. Of a Cartilage.	Page 579
II. Of a Ligament.	581
III. Of the Nails.	584

The

An humane body may be considered either as

with respect to each part of which it consists.

The First Book.

ken notice of its external form or shape, its bulk, and its colour. But these accidents being

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OF THE

LOWEST CAVITY.

CALLER

ABDOMEN.

CHAP. I.

*Of the division of the parts of the Body of Man
in general.*

ANATOMY is an artificial separation of the parts of the Body by section, instituted for attaining to the knowledge of its frame, and the use of each part.

An humane Body is the primary subject of Anatomy; both as it is the most perfect of all other, and also because the Anatomist dissects other creatures onely in order to the more perfect understanding of It, the preservation and cure where-

The body
considered
in two re-
spects.

1. Gene-
rally.

of is the principal and ultimate end of this art.

An humane body may be considered either *generally*, with respect to the *whole*; or *particularly*, with respect to each *part* of which it consists.

In its *general* consideration there are to be taken notice of, its external form or shape, its bulk, and its colour. But these Accidents being obvious to the eye of every man as well as to the Anatomists, are no proper subjects for our discourse.

2. Parti-
cularly.

The *particular* consideration of it observes and demonstrates the figure, connexion and composition or structure of each several part, and the great diversity of their actions and uses.

A Part
defined.

Now a *Part* may be thus defined, *viz.* It is a *bodily or solid substance*, *cohering with, making up, and partaking of the life of, the whole, and serving for some function or use.*

In this definition are implied these five things.

1. A part must be *solid*, whereby the spirits and humours are excluded.

2. It must *cohere* with the whole, that is, be not onely contiguous, but continuous to it: and from hence also the spirits and humours are excepted, as onely touching the sides of the vessels as they pass along, being contained in them, but not united to them.

3. It (with others) must serve to *complete or make up* the whole. Whence the child in the womb is not to be reckoned a part of a pregnant woman, though it be knit to her womb by the Navel-strings (the *placenta* intervening) because after delivery she remains a perfect woman, as she was also before conception.

4. It must partake of the *life* of the whole: whereby the nails and hairs are exempted.

And

And 5. It must have some *function*, or *use*: so that preternatural excrescencies, as Warts, &c. are not to be reputed parts, (being also excluded by the third head, as contributing nothing to the perfection of the whole.)

Having mentioned the *function* and *use* of a part, it will be convenient to explain what is meant by them, and to distinguish them.

The *function* (or *action*) of an (organical) part, is a certain effective or operating motion produced by it, from its own proper aptitude. And is either private, or publick. By the private action the parts onely provide for themselves; but by the publick, for the whole animal. As for instance: The stomach by a private action converts the blood that is brought to it by the Arteries, into its own nourishment: But by its publick action, which is Concoction or turning the food into Chyle, it provides for the whole body.

The *use* of a part is that assistance which the less principal parts afford to the principal one in performing its action. And it differs from the *action* of a part in two respects. First, in that those parts onely are said to have an *action*, which operate; whereas many have an *use*, which act nothing at all themselves, but onely accommodate and assist those that do act. Thus the Fat has no *action* of its own, but it is usefull to cherish and moisten the Muscles, &c. that their motion or action may be performed more glibly and easily. Secondly, an *action* belongs to or proceedeth from the whole organ that operates; but every particular part that makes up the organ, hath an *use*. Thus the whole Muscle exerts its *action*, which is contraction: but the several parts of which a Muscle consists, have each of

them their *use* to assist this action; as, the membrane that invests it, is of use to inclose and contain its fibres, and to distinguish and keep it apart from other muscles; the use of the nerve is to bring it animal spirit; of the artery, to supply it with blood, &c. But because the *action* of a less principal part, may be of *use* to further that of one more principal; as also because the *action* of several organs may conspire to one *use* (as the Muscles of the *Abdomen*, to the exclusion of the excrements) therefore *Action* and *Use* are often confounded and used the one for the other by Anatomists; nor shall we every where in the following tract distinguish them so nicely.

The division of the parts.

1. From their matter, viz. into similar,

The parts of the body have a twofold difference or distinction; the one from their *matter*, and the other from their *function* or *end*.

In respect to the *matter* of which they consist, they are divided into *similar* and *dissimilar*.

A *similar* part is that which being cut or divided into several pieces, they will be all of the same nature, substance and denomination with one another and with the whole: as every portion of a *bone* is *bone*. It is otherwise called a *simple* part.

Of *similar* parts there are commonly reckoned ten in number; to wit, The *skin*, a *membrane*, the *flesh*, a *fibre*, a *vein*, an *artery*, a *nerve*, a *ligament*, a *cartilage*, a *bone*.

But when these are called *similar*, it is not so to be understood, as if they were truly and simply so; (for their particles are compounded of divers elements:) but onely that they appear so to the eye; and to distinguish them from the compound parts, whose diversity of substance the eye plainly discovers.

These

These *similar* parts are vulgarly subdivided into *Spermatical*, and *Sanguineous*; as if some of them in the first formation of the young were made of seed, and others of blood. But that is an ancient error: for all of them are equally first delineated out of the liquor contained in the *ovum* or conception, which has used to be called seed (as shall be shewn afterwards in this book, chap. 30.) However the parts thus distinguished have this difference the one from the other, that those called *spermatical* (which are a *bone*, a *cartilage*, a *ligament*, a *membrane*, a *fibre*, a *nerve*, an *artery* and a *vein*). being cut in two, or broken, are not regenerated, nor can truly be again united; but are onely joyn'd by a *callus*: whereas those called *sanguineous*, are regenerated; such is all the *muscular* flesh. As for the *skin*, it seems to partake of the nature of both; for though in grown men a wound in it is healed onely with a *scar*; yet in boys it has been observed to be closed with a true and proper *skin*. But of its nature see more in the third chapter.

A *dissimilar* part is that whose portions are neither of the same substance, nor the same denomination; as a *muscle*, in the which are a *membrane*, *flesh*, a *tendon*, &c. It is otherwise called a *compound* part.

and dissimilar.

In respect of their function or end the Parts are divided into *Organical* and *Non-organical*.

An *organical* part is that which is designed for performing some action. Such as are chiefly the *dissimilar* parts; but yet some of the *similar* may be also termed *organical*; as for instance, a *Nerve*, which conveys and distributes the *Animal Spirits*; and likewise the *Arteries*, which doe the same to the blood.

2. From their function or end, viz. into Organical,

and Non-organical: A *Non-organical* part is that which has only an use and no action : as a gristle, fat, &c.

as also into principal, Again in respect of their *function* or *end*, the Parts are divided into *Principal* and *Ministring*.

A *principal* part is that which performs the most noble and principal action, and from which the actions of many other parts proceed or are assisted. Of which sort are 1. The *Heart*, which is the fountain of vital heat and the *primum mobile* of the body. 2. The *Brain*, which is the fountain of the *Animal Spirits*, and so the Author of all sense and motion. To these some add 3. the *Genitals*, on which the preservation of the Species depends ; as on the other, that of the Individual.

and ministring. A *ministring* part is that which ministers to or assists the principal : such as are the *Stomach*, *Liver*, *Reins*, the *Hand*, &c. And of these some are *necessary*, others *not*.

The ministring are either necessary, The *necessary* are those without which a man cannot live. Such as are the *Stomach*, *Liver*, *Lungs*, &c.

or not necessary. The *not necessary* are such as contribute to the well being, but are not absolutely necessary to the life of a man : as an *Hand*, a *Leg*, *Simple flesh*, which in consumptive persons is almost wholly spent ; and *Insects*, according to *Aristotle*, have none.

There are also other divisions of the parts of the Body, as into parts *containing*, parts *contained*, and the *spirits*, express'd by *æthereæ*, or *impetum facientes*, by *Hippocrates*. But thus much as to the division of the *Parts*.

The division of the whole body. The *whole* body is divided into the *Trunk* containing three *Ventricles*, and the *Limbs*. The three *Ventricles* are the *Cavities* of the *Abdomen* or

Chap. II. *Of the bounds, &c. of the Belly.*

7

or Belly, Chest and Head. The Limbs are the Arms, Thighs and Legs.

Fernelius divides the Body also into *publick* and *private Regions*. The *private* are such as the brain, reins, womb, &c. The *publick* are Three. The first includes the *Vena portæ* and all the parts whither its branches reach. The second begins at the roots of the *Cava* and ends in the small veins before they become capillary. The third contains the muscles, bones and the bulk of the Body, and is terminated by the skin. But this division is onely of use in Physick.

C H A P. II.

Of the circumscription, regions and parts of the Abdomen.

IN the former Chapter we divided the *Whole* Body into the *Ventricles* and *Limbs*. Of which because the *Ventricles* are far more subject to putrefaction, as containing parts that are very moist and flaggy, whereas the *Limbs* consist of parts that are more dry and firm, such as the Bones, Muscles and Tendons; I say on this account the *Ventricles* are usually first dissected, and of them first of all the *Abdomen* or Lower Belly that contains the Guts, which of all other parts are aptest in a short time to send forth noisome smells, and to be offensive to the Anatomist. We shall begin with it therefore, and in the second place proceed to the middle Ventricle or *Chest*, and last of all to the *Head*: and each of these will be the subject of a particular Book.

Before we begin to cut open the *Abdomen*; three things are to be considered in relation to it. First, its *circumscription* or *bounds*. Secondly, its *regions*. Thirdly, the *special* or *constituent parts* of it.

The cir-
cumscrip-
tion of the
Abdomen.

As concerning the *circumscription* of it, its *upper* part is severed (within) from the *Breast* by the *Midriff*. In the *fore-side* it is bounded *above* by the *cartilago ensiformis*, or the *Heart-pit*, and *beneath* by the *Share-bones*. On the *sides*, by the *short Ribs* and *ossa Ilia* or *Hip-bones*. *Behind*, by the *vertebræ* of the *Loins*, or *sacrum* and the *coccyx*.

Its Regi-
ons.
1. Anteri-
our,

Its *Regions* are either *Anterior*, or *Posterior*. The *Anterior* (which comprehends also the *Lateral*) is subdivided into three others, *viz.* the *uppermost*, *middle* and *lowermost*.

The *uppermost*, which reaches from the *cartilago ensiformis* to within three inches above the *Navel*, (about the ending of the *short Ribs*) hath three parts. Two *lateral*, which are called *hypochondria*, or *subcartilaginea*, because they lie under the cartilages of the *short Ribs*. In the *right hypochondrium* lieth the greatest part of the *Liver*, and part of the *Stomach*; and in the *left*, the *Spleen*, and a greater part of the *Stomach*. The third part is that which lieth *before*, between the two *lateral* parts, and is properly called *epigastrium*, because the (middle of the) *Stomach* lieth under it. In this part remarkable is the *Pit* of the *Breast*, which formerly has used to be called *reges*, but *scrobiculus cordis* by the modern *Writers*.

The *middle* region extendeth it self from three inches above the *Navel*, to three inches under it. The *fore-part* is that where the *Navel* is, from whence

Chap. II. Of the regions of the Belly.

9

whence it is called *regio umbilicalis*. The two lateral parts are called in English the *Flanks*; in Latin *Iliæ*; by Aristotle *λαγνῆς*, either from their laxity, or softness, or from *λαγνεία*, *salacitas*, as if they were the seat of lust; by Galen *κενῶν*, because being placed between the *ossæ Iliæ* and Ribs they are lank, and seem empty. They are called by Dr. Glisson *epicolicæ*, because on each side, this region investeth the lateral parts of the Gut *Colon*.

The lowest region is called *υπογάστριον*, *hypogastrium*. This region reacheth from three inches below the Navel, to the *os pubis* and Groins; and hath three parts; two lateral, and one anterior or middle. The lateral are bounded by the *ossæ Iliæ*, so called because a great part of the *Ilium intestinum* lieth under them on each side. Besides this, in the right lateral part are placed the beginning of the *Colon*, and all the *Cæcum intestinum*. In the left are contained the ending of the *Colon*, and beginning of the *intestinum Rectum*.

The fore-part of the *Hypogastrium* by Aristot. lib. 1. Hist. animal. 3. is called *ἡτὸν*, by some (in special) *Abdomen*. At the lower part of it is seated the *pubes*, which in the adult or ripe of age is covered with hair; and on each side of this, the Groins, called *εσχῶν*, or *Inguina*. Within this fore-part of the middle Region are contained part of the Mesentery and small Guts, the Bladder, and in Women the Womb.

The posterior Region is divided into two Parts, 2. Posterior, the upper and lower.

The upper is called the region of the Loins, reaching from the root of the Midriff to the top of *os sacrum*, and contains within it the Kidneys, the *Pancreas* and centre of the Mesentery, the Recep-
tacle

trunk of the Chyle and the descending trunks of the *Cava* and *Aorta*.

The lower part of the hinder Region reaches from the top of *os sacrum* to the lower end of the Rump-bone or *coccyx*. It is much broader above than below, and within it are included the straight Gut, the Ureters, and in Women the Testicles or *Ovaria*, &c.

Its Parts.

The parts of the Abdomen are Containing (or outer;) and Contained (or inner.)

Containing,

The containing parts are such as are either common to it with the rest of the Body; or are proper to the Abdomen alone.

and Contained.

The parts contained serve either for nutrition, or for separation of excrements, or for generation. Of all which in order, and first of the Common Containing parts.

CHAP. III.

Of the common containing parts of the Belly.

THE common containing parts of the Belly are five, the Cuticle, the skin, the fat, the *membrana carnosæ*, and the common membrane of the Muscles.

The skin in Man is called in Latin *cutis*, but in Beasts *aluta*, the pelt or hide; in Greek it is called *Sequa*, and *Seis* either from *Seis*, to fley; or *q. rigua*, seeing it is the end or superficial boundary of the Body. Of all the membranes of the Body it is the thickest.

It

It hath a double substance, an outer and an inner. The outer is known by the name of *cuticula* or the *scarf-skin*, and the inner by the name of the *true skin*. I. Cuticula, or scarf-skin.

The *Scarf-skin*, in Greek, is named *ἐπίδερμις* *epidermis* because it is placed upon the true skin as a covering. It is as large as the true skin, and more compact; for waterish sharp humours, passing through that, are stayed by the thickness of this, when Pustules arise. It is without blood and without feeling.

The material cause of it is a viscous and oleous vapour of the blood, raised and exhaled by the natural heat of the subjacent parts, and dried and condensed by the external cold, as most Anatomists have taught; but Dr. Glisson thinks it to be a soft, slippery, viscid and transparent juice (like the white of an Egg) issuing out of the capillary extremities of the Nerves which end in the outer superficies of the true skin, where it is coagulated, and by its viscosity sticketh upon it like glue; so that it can hardly be separated therefrom by a knife, but may easily by a vesicatory. It sometimes also almost wholly peels off in burning fevers, and the small pox; but a new one presently succeeds it. *Diemerbroeck* thinks it is bred neither of these ways, but has a seminal principle as well as the skin it self, or any other solid part. But not so probably, seeing it has no sense, and may be often quite lost, and yet presently regenerated; all which circumstances agree to no part that has a seminal principle. And whereas he objects, that because Infants when they are born have a scarf-skin, therefore it cannot be bred by condensation, seeing there is neither cold nor dryness in the womb, but on the

the contrary warmth and moisture, which will hinder all condensation; Dr *Glisson* solves this objection by shewing how a liquor may be condensed or indurated two ways; the one, by separation of the thinner parts by way of exhalation, which is properly called *desiccation*; and this he confesses cannot happen in the womb; the other, by *coagulation*, that is, by separating the more serous part of the matter from the thicker particles; which sort of condensation may take place well enough in the womb. See his *tract. de ventric. &c.* p. 11, 12. where he very clearly makes this out.

Uses. The use of it is, First, to defend the Skin, (which is of an exquisite sense) from external immoderate either heat or cold. In cold weather it breaketh the cold, that the perspiration should not be altogether hindred: In hot weather by its compactness it hindreth too great perspiration. Secondly, to be a middle between the skin and the object to be felt; for when it is rubb'd off, the true Skin cannot endure the touch of other Bodies without pain. Thirdly, to stay the ichorous substance from issuing from the Arteries; for this we see to happen when the *cuticula* is rubbed off by any means.

Fourthly, to make the Body more beautifull; which it does by smoothing the asperities of the true Skin, and inducing a comely colour of white and red. Whiteness is natural to this part, and the redness is owing to the blood that is affus'd to the outward superficies of the true Skin; which being seen through the Skarf-skin makes that florid colour.

Lastly, it serves for the firmation and fixing of

Chap. III. Of the common containing parts.

13

of the hairs, which sprout through its pores. Whence if it be fretted off by chance and be long wanting, the hairs easily shed off.

The true skin is a great deal thicker than the cuticula; some say, six times. 2. The true skin.

It is naturally white, as other membranes; Its colour, but in living and healthfull persons, and such as live in a temperate or somewhat cold climate, from the afflux of the blood towards it, it is of a reddish rose colour. But in those that live under the Æquinoctial Line and in excessively hot climates it appears black in the outer superficies, because they having a softer skin, and large pores and loose, many vapours of the adust humours are raised with the sweat; the grosser substance whereof, (being stopt by the Scarf-skin, and) by reason of the excessive heat, being dried and scorched, causeth that blackness; for their infants are not born black, but reddish.

It is made up of nervous fibres very closely interwoven one with another, and of a parenchyma that fills up the interstices and inequalities thereof. That it has such a parenchyma may appear by this, that when a Sheep-skin (for instance) has been some while steeped in water, one may with an ivory knife or the like scrape a great deal of mucous slimy matter off it, whereby it becomes much lighter, thinner and in some measure transparent, as we see in Parchment. Matter.

The Skin in the Forehead and Sides is thin, thinner yet in the palm of the Hand, but thinnest of all in the Lips. In the Head, Back, and under the Heel it is thickest. It is thinner in Children and Women than in Men; and in those that live in hot Countries, than those that live in cold. And Difference of thickness.
this

this (as *Spigelius* observes) is the reason why those that are born in cold Countries, when they come under the *Æquinoctial Line*, are often taken with fevers, because that great heat that is there excited in the Body by the outward air, cannot exhale through the too thick Skin, but being retained induces a preternatural heat, and so a fever.

Pores,
tempera-
ture and
vessels.

It is full of pores as well as the *cuticula*, for the perspiration of vapours from the subjacent parts. It is of a most exact temperature, neither too cold nor too hot; that it might the more accurately judge of the temperature of all tangible things. Its nervous part, which is naturally cold, is attemper'd by the heat of the arterial blood that flows continually for the supply of its parenchymatous part: and its *parenchyma* is not heated too much by the afflux of the blood, because it is lodged amongst so numerous cold nervous fibres. It has very many both capillary *Arteries* and *Veins* distributed through it; as also *Nervous* twigs, which by conveying the Animal spirits to it, endue it with a most exquisite sense.

Action.

The Skin hath an *action*, to wit, the sense of feeling.

Uses.

Its use is, first, to cloath the whole Body, and defend it from injuries. Secondly, to be a general vent or emunctory to the Body, by which all its exhalations may fitly transpire. Which whether it be done onely through its pores, as most Anatomists have affirmed; or also through its very substance, as Dr. *Glisson* has of late asserted, is a controversie hardly worth the insisting on.

Lastly, in several places of the body to put forth and nourish the hair, for the fence and ornament of the respective parts.

In

In the next place appears the *Fat*, which is 3. *Fat*. commonly taken to be something distinct from the *membrana carnea* that lies under it; but is indeed onely a part of it: for that membrane in its outer part is full of membranous cells, which are fill'd with a yellowish fat, somewhat like as the cells in the pulp of an Orange are filled with its juice. But however seeing the inner part of it is not equally full of cells, but more united and close, and so seems of another substance, we shall follow the old distinction, calling its outer part the *Fat*, and its inner, the *carnous membrane*.

Fat is defined to be a greasie substance, bred of Its definition. the oily portion of the aliment and blood, condensed by cold.

In Men it is placed next under the skin, and that all the Body over, except in the Lips, the upper part of the Ear, Eye-lids, Cod and Yard, which have no fat at all; and in the Forehead, where the skin cleaveth close to the carnous membrane, by means whereof we can move the skin of our Forehead, even as Beasts can that of their whole body by the same reason, viz. because in most of them the skin is immediately and closely joined to the said membrane, which in them is musculous. Situation.

This *Fat* is properly called *pinguedo*, whereas that of the Caul, &c. is called *serum*, Suer or Tallow. And they differ in this, that *pinguedo* is easily melted; but not so easily congealed; whereas *serum* is not easily melted, but is easily congealed. Besides, *pinguedo* is not brittle, but *serum* is.

The uses of it are these; First, it defendeth the Body from the external air. Uses.

Secondly, it preserveth the natural heat.

Thirdly, it furthereth beauty by filling up the interstices of the Muscles and wrinkles of the Skin; whence very lean people look shrivel'd and deformed.

Fourthly, by filling up the empty spaces between the Muscles, it rendreth the motion thereof more glib and easie, (so it do not abound too much) and keepeth all the parts from driness, or breaking. Hence it besinears the extremities of the Cartilages, the jointings of the greater Bones, and the Vessels that they may pass safely.

4. Mem-
brana car-
nosa.

The *Carnous membrane* is onely properly so called in Brutes, in whom it is truly *fleshy* and muscular; but in Man it may more properly be called *membrana adiposa*, or the fatty membrane, according to Dr. Glisson, seeing it has no carnous fibres or *parenchyma*, but is a membranous substance frust with some fat. The outer part, because it abounds with *fat* we have already described under that name: but this which is the inner, being more membranous and less fatty, we shall call, after the said Authour, the *fatty membrane*: or if we name it the *carnous membrane*, it is onely less properly, as fat is reckoned to be a sort of flesh. Onely in the Forehead and Neck it looks somewhat fleshy, and therefore may in those places with better reason be called so.

Its use.

The *uses* that we ascribed to the *fat* agree also to this membrane, *viz.* to defend the body from external cold, and to preserve the natural heat, &c. yea it serves also to sustain and strengthen the vessels that pass betwixt the skin and muscles, between which it is placed. Some make this mem-

membrane the seat of that horror or shivering that happens in the beginning of Ague-fits, supposing it to be of exquisite sense, and that it is then twitched by sharp humours. But I think that symptom rather proceeds from the like affection of the membrane next under it, which is

The common membrane of the Muscles. This is ^{5. The common membrane of the Muscles.} spread over all the body (except the skull, according to some) and is knit by fibres somewhat loosely both to the foregoing that lies above it, and to the proper membrane of each Muscle that lie under it. It is very thin, but strong: It is not yellow like the former, but whiter and more transparent.

It serves as a common bagg to contain the Muscles in, and helps to keep them in their proper places.

In the next place (according to the usual method of Anatomists) we should come to speak of the Muscles of the Abdomen; But we have thought it more convenient to treat of the Muscles of the whole Body in a particular Book, and so shall but onely name those of the lower Belly here, as they appear one after another to the Dissector. And first there shew themselves the *obliquely descending* pair; secondly, the *obliquely ascending*; thirdly, the *Recti*; fourthly, the *Pyramidal*; and lastly, the *transverse*. All these being removed, there appears the *peritonæum*, of which in the next Chapter.

C

CHAP.

C H A P. IV.

Of the proper containing parts.

TH E proper containing parts are the *Muscles* of the Belly, and the *Peritonæum*. Of these *Muscles* we shall speak *Book 5. Chap. 17.*

The Peri-
tonæum.

The *Peritonæum* or inmost coat of the Belly, commonly called its Rim, (derived from *desseins*, from its office of *encompassing*) adheres *above* to the Midriff, *below* to the Share and Flank-bones; in the *fore-part* firmly to the transverse *Muscles*, but chiefly to their Tendons about the *Linea alba*; *behind* to the fleshy heads of these *Muscles* loosely. The end of this connexion is both for its own strength, and that it may the better comply with and serve the muscles in their compression of the Belly.

Its figure
and sub-
stance.

Its figure is oval; and its substance membranous. The inner superficies of it, which respects the Guts, is smooth, equal and slippery, bedewed with a kind of watery humour contained in the *Abdomen*: but the outer superficies, whereby it cleaves to the *aforesaid* Bones and *Muscles*, is rough and unequal.

Origine.

As for the *origine* of it, *Fallopins* will have it to proceed from the superiour and inferiour plexus of Nerves of the *Abdomen*; for from them it cannot be separated without tearing. To him *Dr. Glisson* assents. Some derive it from the Ligaments by which the *vertebræ* of the Loins and of *Os sacrum* are tied together, especially from those of the first and third of the Loins, because it is there thickest. *Diemerbroeck* denies it to have any
origine

origine at all, other than the first seminal matter out of which it was formed in the womb. But that is onely its *material* principle, and hinders not but that it may have (according to Dr. Glisson's distinction) a principle or origine of *continuation*.

It is *double* every where; but appears so to be chiefly about the *vertebrae* of the Loins, and in the *Hypogastrium*. For in the former place between its membranes lie the *Vena cava*, the *Aorta*, the Receptacle of the Chyle, and the Kidneys; and in the latter the Bladder and Matrix.

Duplicity.

Above, where it is tied to the Midriff, it has three *foramina* or holes; the first on the right side, whereby the ascending trunk of the *Vena cava* passes; the second on the left side, for the Gullet (with the Nerves of the eighth pair inserted into the mouth of the Stomach) to descend by; the third behind, by which the great Artery or *Aorta*, and the intercostal Nerve descend, and the *ductus chyloferus* ascends. Below, it has passages for the straight Gut, for the neck of the Bladder, and in Women for the neck of the Womb; also for the Veins, Arteries and Nerves that pass down to the Thighs. Before, in the *fetus*, for the umbilical Vessels, to pass in and out by.

Perforations.

It has two remarkable *Processes* in men placed before, by the *os pubis*, on each side one. They are certain oblong productions of its outer Membrane passing through the holes of the Tendons of the oblique and transverse Muscles, and depending into the Cod, there bestowing one Tunicle on the Stones, and containing them like a bag. There are also two *Processes* in Women, but they reach onely to the *Inguina* or Groins, and terminate in the upper part of the Privy, or the fat of *mons Veneris*. The inner

Processes.

Membrane of the *peritoneum* (in Men) reaches but to the very holes, through which the Processes descend, which it makes very strait; but being either relaxed or broken, the outer gives way, and so there follows a rupture, either the Caul, or the Guts, or both falling down thereby into the Cod. By the holes of the Processes there descend in Men the Vessels preparing the seed, and the Muscles called *Cremasteres*; and by them ascend the Vessels bringing back the seed. In Women there pass by them the round ligaments of the Womb, which after spreading themselves and growing jagged, are either joined to the *Clitoris*, or else terminate before they come at it, in the fat of *Mons Veneris*.

Vessels.

It has *Arteries* and *Veins* from the Mammary and Epigastrick, and from those of the Midriff, or the Phrenick. It has slender threads of *Nerves* from the pairs of the *Vertebrae* of the Loins chiefly.

Use.

Its use is to assist the equal and orderly contraction of the belly for the expulsion of the excrements, and by its smoothness to prevent the Guts being hurt by the circumjacent parts. Its several other uses may be observed in the foregoing description of it.

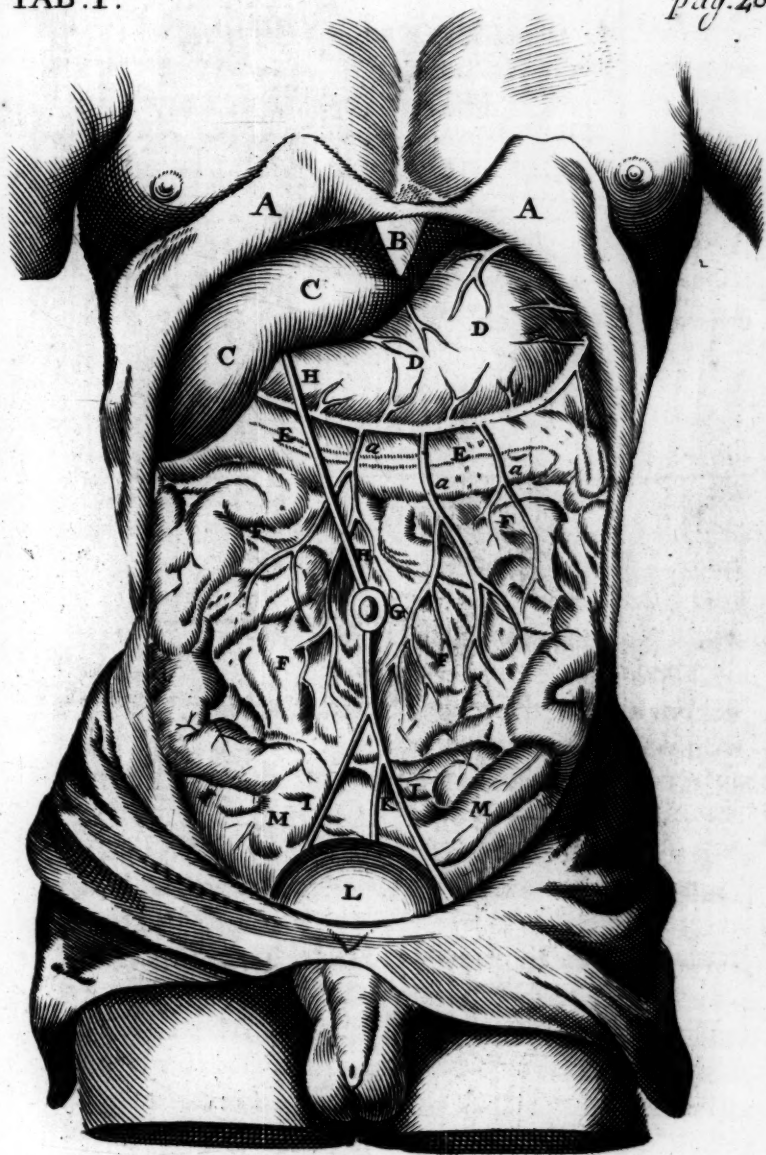
And thus far of the parts *Containing*.

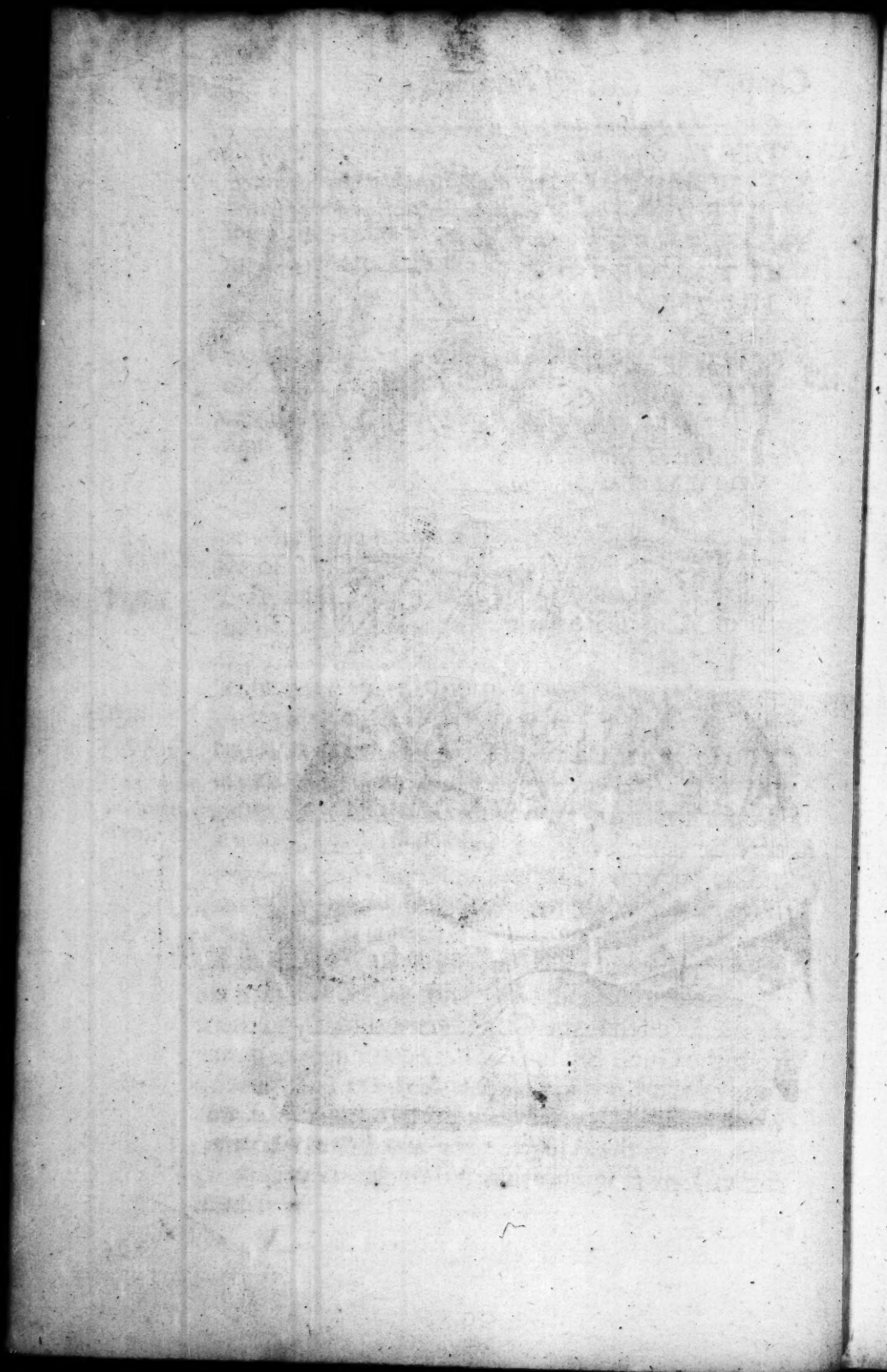
Tab. I. shews the parts contained in the *Abdomen* as they appear after all the containing parts are removed.

AA The coverings (both common and proper) of the Abdomen dissected, and turned back, that the inner parts may come to view.

B The sword-pointed Gristle, or cartilago ensiformis.

CC The





CC The gibbous part of the Liver.

DD The Stomach.

EE Part of the Colon placed under the Stomach.

FFFF The upper membrane of the Omentum knit to the bottom of the Stomach.

G The Navel.

HH The umbilical Vein,

II The two umbilical Arteries.

K The Urachus.

L The Bladder.

aaa The gastroepiploical Vessels dispersed through the Caul and Stomach.

MMMM The Intestines.

CHAP. V.

Of the Omentum.

THE parts Contained serve either for nutrition, (and separation of excrements) or procreation. As for the parts serving for nutrition, they either serve for chylification, or sanguification.

The principal Efficient cause of chylification, is the Stomach; but the Adjuvants are the Caul, Pancreas; &c.

The principal efficient causes of sanguification, were held to be the Liver and Spleen, so long as it was believed that the Chyle went directly to them from the Guts: But since it has been discover'd that none of the *vina lactea* pass to them, but that the whole Chyle is conveyed directly by the *ductus thoracicus* to the Heart, they are discharged from the task of sanguification; though they do contribute

tribute to the refining and perfecting of the Blood already made,

The *Excrements of Chylification* are received by the *Guts*. The excrements of *Sanguification* have been taught to be two, *viz.* choler and the serous humour. Choler is separated by the *Liver*, and is received the thinner part of it by the *vesica fellea*; but the thicker by the *porus biliaris*. The serous humour is separated by the *Kidneys*, and from thence conveyed to the *Bladder* by the *Ureters*.

The parts appointed for *procreation*, are the *Genitals*, both in Men and Women,

The Caul. Next then to the *Peritonæum* is the *Caul*; in *Its Names.* Greek it is called *ἐπιπλοον*, from *ἐπιπλέω*, *innato*, because it seemeth to swim upon the *Guts*. In Latin, *Omentum*, from *Omen*, because the Soothsayers used to divine by it; and otherwise *Rete*, or *Reticulum*, from its contexture, which is *Net-like*; whence also in English it is commonly called the *Net*.

Substance. It is composed of two *Membranes*, betwixt which the *Vessels* run, and the *Fat* and *Glands* are placed. They are very thin, and, where the *Fat* hinders not, transparent.

Figure. For shape it is compared by *Dr. Glisson* to a *Womans Apron*, when the lower part of it is turn'd up and tuck'd under the girdle. For it consists of two *Leaves*, whose upper edges are knit to different parts; but its bottom is continued, and is like the bottom of a *Satchel*, to which it is also compared by some.

Connexion. I say its upper edges are knit to different parts: for the *fore Leaf* adheres to the under or hollow side of the *Liver*, to the *duodenum* and *pylorus* (somewhat towards their fore-side) to the bottom of

of the Stomach and to the suture of the Spleen. The *hinder* or *inner* Leaf is continued from the former, and passing from the Spleen backwards returns towards the right side again, by the way adhering to the *Pancreas*, to that part of the *Colon* that runs under the Stomach, to the Back, to the *duodenum* (somewhat towards its back-side) and at last is joined or continued to the fore Leaf on the hollow side of the Liver. As for its lower part, it is knit to no part, but hangs loose upon the Guts, reaching commonly a little below the Navel, but sometimes to the very bottom of the Belly.

It is commonly said to have a double *origine*, *Rise*. namely, its fore leaf to spring from the Stomach, and its hinder from the *Colon*. But seeing both these have their outer Coats from the *peritonæum*, and that the Caul it self cleaves also to it at the back, it is most reasonable to draw its rise from thence. Whence descending to below the Navel, it turns up again, and ascending to the Stomach, cleaves to it; and so may more properly be said to end, than to begin there.

Betwixt its Leaves or Walls there is formed a *Cavity*. notable cavity, which some very weakly have design'd to divers uses; whereas it results onely accidentally, and was not framed by Nature for its own sake. "For (as Dr. *Glisson* reasoneth) "whilst Nature is solicitous about providing "a fit deputy for the Mesentery (and that membranous) and stuffing it with fat, through which "Vessels may be carried to the Stomach, Liver, "Spleen, *Pancreas* and *Colon*, and whereby she "may joyn all those parts after a due manner; "and moreover whilst she takes care that it hang "down loosely, and besmear both the Stomach

“and Intestines with its unctuousness; and in
 “the mean while be every where continuous to
 “it self: I say, whilst she diligently proposes all
 “these ends, if she will obtain them, she must
 “needs make the Caul hollow as it is above de-
 “scribed, and its propending part must needs imi-
 “tate the bottom of a pouch.]”

Its vessels.
 I. Arteries.

The *Omentum* aboundeth with Vessels of several sorts, but such as do not properly belong to it or terminate in it, but are carried through it to other parts, from which they are for the greatest part denominated. We shall begin with the *Arteries*, and translate hither the account that the above-named Doctor gives of them, and also of the *Veins*, which is very exact. “Its Arteries are propagated from the *Celiacæ*; or rather its inner Leaf, near its origine, receives and upholds this Artery, (as soon as it springs out of the *Aorta*) betwixt its Membranes. It is divided into two branches, the *right* and *left*. The *right* being joyned to the *vena porta* in the *pancreas*, and fenced with the Membranes of the *omentum*, is carried into the hollow side of the Liver: but it first sends forth these branches; the *pyloricus*, to the hinder side of the right orifice of the Stomach; the *arteriæ cysticæ gemellæ*, the *epiplois dextra*, a portion whereof is dispensed to the Gut Colon; the *intestinalis*, carried to the *duodenum* and beginning of the *jejunum*; the *gastro-epiplois dextra*, which is distributed into the right bottom of the Stomach—The *left* branch of the *celiacæ*, called *splenicus*, is greater than the *right*, and being included within the Membranes of the hinder Leaf of the *omentum* is carried directly left-ways under the bottom of the Stomach to the future of the Spleen.

In

" In its passage it sends forth many branches : Up-
 " wards, one notable one called *arteria gastrica*,
 " which spreads it self through the bottom and
 " sides of the Stomach, and its upper orifice, where
 " it gets the name of *coronaria* ; also a second cal-
 " led *gastro-epiplois sinistra*, whereof one portion is
 " dispersed into the bottom of the left part of the
 " Stomach, and both its fore and hinder parts,
 " and the remainder is spent on the fore Leaf of
 " the *omentum* ; it sends forth a third also, that
 " famous branch called *vas breve arteriosum*,
 " which is inserted into the left part of the
 " left orifice of the Stomach. Downwards also
 " it shoots forth some branches, as the *epiplois*
 " *sinistra*, which being divided into two rivulets
 " waters partly the hinder Leaf of the *omentum*,
 " and partly the *colon* it self ; also another little
 " branch which is wholly spent on the left part
 " of the hinder Leaf of the Caul.

" The *Veins* that answer to the said Arteries 2. *Veins.*
 " rise almost all from the *splenick* branch ; the trunk
 " of which Veins, after it is joyned with the stem
 " of the *splenick* Artery, puts forth branches
 " exactly answering and proportioned to those of
 " the said Artery ; and all the branches of both
 " Vessels are dispensed to the same respective
 " parts, and are denominated from them, so that
 " 'twould be needless to stay longer on their di-
 " stribution : onely the branch that goes to the
 " right orifice of the Ventricle, called of some
 " *pyloricus*, takes its rise from the trunk of the
 " *porta* before 'tis divided.

" It has but very small Nerves proceeding from 3. *Nerves.*
 " the intercostal or ninth pair : which, as the Veins,
 " accompanying the Arteries and having the same
 " names, we shall not take the pains to trace.

But

4. Vasa
adiposa.

But besides these Vessels formerly known, *Malpighius* thinks that he has discovered a new sort, which he calls *ductus adiposi*, and will have to nourish and encrease the Fat, discharging the Arteries and Veins from that office. "He says they are so very small that they admit not a ligature, from whence one might discover their nature, *viz.* whether they be hollow, so as that the fat might be propagated by them as by pipes; or whether they be onely like filaments or small threads, along which the fatty particles drill. But he inclines to think, they are hollow like Veins. He confesses, that he could not yet discover by the Eye from whence they take their rise, though he has endeavoured to find it out in many, and those divers, sorts of Animals: but thinks it probable that they either spring from the Spleen, or from the Stomach. The chief reason why he suspects they may spring from the Spleen is, that there are abundance of fibrous bodies discernible therein that run through its parenchyma from one membrane to another, and have no communication with the bloud-vessels. These, he says, so far as he could perceive, are closely knit to the membrane of the Caul that enters the line or future of the Spleen with the Splenick vessel; and seeing it appears not as yet, whether they be hollow, or of what origine they are, or what use they serve for, one may reasonably doubt whether they be not the first root of these *ductus adiposi*, or at least have communication with them. As for their rise from the Stomach this may be said, That the Caul has a notable connexion with it, being knit strongly to it through its whole length, and receiving
" bloud.

“ bloud-vessels from it. That in some Fish there
 “ grows a notable membrane from the bottom of
 “ the Stomach, that has vessels differing from
 “ the sanguineous. And he thinks it not unrea-
 “ sonable to suppose, seeing in the Stomach, and
 “ in the Intestines that are continued to it, by
 “ means of the attrition and exquisite solution of
 “ the food, the particles of it acquire such a liber-
 “ ty, that those that were originally in it being
 “ let loose, or by a new mixture and mutual
 “ adaptation being shaped and conglobated into
 “ a new nature, have new motions and actions; I
 “ say seeing by these means there may not want
 “ matter for propagating of Fat, it will not be
 “ improbable that there are proper vessels also
 “ for the propagating of it and conveying it to
 “ the parts.] Thus that curious person. But
 whether there be indeed such peculiar vessels, I
 cannot affirm, having never been able to disco-
 ver them by the naked eye, or by such glasses as
 I have made use of.

Dr. Wharton in his Book *de Glandulis*, cap. 12. 5. Venæ
 declares, that he has observed some *venæ lacteæ* lacteæ,
 arising out of the bottom of the Stomach, (*Die-*
merbroeck says, from the beginning of the *jejunum*)
 which are received into the *omentum*, and being
 inserted into a pretty large gland do from thence
 spring again, and are carried obliquely down-
 wards, crossing the right extremity of the *pan-*
creas: one would think, saith he, at the first
 sight, that they enter'd into the *pancreas*, but
 they do in truth pass by it, and make towards
 the common receptacle of the Chyle, into which
 they empty themselves.

The same learned Physician does in the same *Its glands.*
 place give an account of two *Glands* that are na-
 turally

naturally found in it. One *greater* near its being joyned unto the *pylorus*; and into this it is that the *lacteæ* are inserted; another somewhat *less* placed towards the Spleen, and this he has observed sometimes double, triple, yea manifold. Preternaturally it has sometimes many more.

Fat.

The last part of which the Caul consists is its *Fat*, which is not spread equally all over it, but is gathered there chiefly where the Vessels run; the spaces betwixt being onely membranous. It is collected in little membranous cells included betwixt the two investing membranes, and its matter is derived from the bloud-vessels according to the common opinion, but according to *Malpighius* it is communicated by the *ductus adiposi* before described. The fore leaf has more fat than the hinder; and the upper part of the fore leaf that is knit to the Stomach, is the fattest of it. In very fat persons this part grows to a great bulk; but in consumptive people there is little left besides the membranes and vessels; and * *Peyerus* writes that in all hydropick persons that he ever dissected (and he has dissected very many) the Caul was always extenuated and putrid.

* *Metb.*

Hist. Anatom. Med.

p. 97.

Its uses.

The *uses* of it are these: *First*, it cherisheth the internal heat of the lower part of the Stomach, and of the Intestines. Which appears by the story that *Galen* tells of a Fencer, who being wounded in the Belly and the Caul being taken out, afterwards when the wound was healed up, felt great coldness upon his Belly, so that he was forced to wear woollen upon it. Yet *Riolanus* affirms from his own observation, that such as have had the Caul cut out, have found no prejudice by it to their concoction.

Secondly,

Secondly, it ministreth nourishment to the parts in a long want of food; its fat being received into the Veins and mixed with the mass of blood.

Thirdly, like the Mesentery, it serves to convey safely the Vessels to other parts, as to the Stomach, Colon, Duodenum, Spleen, &c.

Fourthly, it keeps the outer superficies of the Guts moist and glib, that they may the better perform their peristaltick motion.

Fifthly, It serves also to knit loosely together the Stomach, Liver, Spleen, Pancreas, Colon and Duodenum. This connexion was to be loose, because the Stomach and Guts are sometimes distended and sometimes empty, and accordingly take up more or less room: but yet it is not so loose, but that it is some stay to them, and partly hinders them from departing out of their places.

CHAP. VI.

Of the Gula.

THE Gullet being as it were the pipe or funnel of the Stomach, though it be seated in the Thorax, and so should be considered in the next Book; yet because of its relation to the Stomach, being but an appendage of it, we shall treat of it here.

It is called in Greek *σώμαχ*, *quasi* *σείς* & *μακρός*, Its Names. because it is narrow and long: As also *οισοφάγ*, *ὅτι οἷον τὸ φάγναι*, because it conveys the meat to the Stomach.

It

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It

Origine
and de-
scend.

It is an organical part, round and hollow, beginning at the root of the Tongue, behind the *larynx* and Windpipe (which part of it is called *pharynx*) and descendeth from thence directly between the Windpipe, the *vertebræ* of the Neck, and the four first *vertebræ* of the *Thorax*, upon which it resteth; but when it is come to the fifth *vertebra*, it giveth way to the descending trunk of the great Artery by bending a little to the right side: afterward accompanying the Artery down to the ninth *vertebra*, there it turns a little to the left again, and climbs upon the Artery; and by and by about the eleventh *vertebra* it passeth through the nervous body of the Midriff towards its left side at a hole distinct from that of the great Artery, and is inserted or continued unto the left orifice of the *Ventricle*.

Substance. It is framed of three *Membranes*. The *outmost* is common to it and the Stomach, and is very thin, being endowed onely with membranous fibres, and those very slender. Some derive its origine from the Midriff, others from the *Pleura*, others from the *Peritonæum*, and others lastly from the ligaments of the *vertebræ* of the Neck and Breast upon which it resteth. "All which
"opinions (according to Dr. *Glisson*) may be
"true, if they be intended onely of an origine
"of continuation or connexion, seeing it is conti-
"nued plainly to the three first, and knit to the
"last: but none of them is true, if they be in-
"tended of a sustaining, or maintaining origine,
"or of a principle of influence. The second or
middle is fleshy and thick, and consists of two
ranks of fleshy Fibres, (what *Fibres* are see B. 5.
ch. 1.) which ascend and descend obliquely,
(spiral-wise) and do mutually intercrossate or cross
one

one another. This hath been held by many (not improbably) to be a kind of Muscle, because it is sometimes affected with Convulsions and Palsies. The third or *innermost* is covered on its inside with a kind of woolly or downy substance: but the remaining part of it is wholly nervous, and hath onely small streight Fibres, as most say; but Dr. Willis affirms it to have fibres of divers kinds, and those diversly woven one with another. It is continued to that Membrane that covereth the Mouth, Jaws and Lips; and (according to Dr. Willis) it descends three fingers breadth below the mouth of the Stomach. From its being thus common to the Mouth, Gullet and upper orifice of the Stomach, proceeds that great consent among these parts in Vomiting, &c.

It hath *Veins* in the Neck from the Jugulars, *Vessels*. in the *Thorax* from the *vena sine pari*; but where it is joyned to the Ventricle, it hath some twigs from the *ramus coronarius*, which proceedeth from the *vena portæ*.

It hath *Arteries* in the Neck from the *Carotides*; in the *Thorax* from the *Intercostals*, and in the *Abdomen* from the *ramus celiacus coronarius*.

Nerves it hath from the *par vagum* or eighth pair.

It hath four *Glandules*; two in the Throat, *Glandules*, which are called *Tonsillæ*, or Almonds, common to it and the *Larynx*, which separate a mucous or pituitous humour to moisten them. (Their description see in Book II. chap. 14.) Other two it hath near its middle, on its out- and back-side, about the fifth *vertebra* of the *Thorax*, namely, where it gives way to the trunk of the *Aorta*, and turns somewhat to the right side, or at that place where the *aspera arteria* is divided into two branches.

ches. These are as big, each of them, as a Kidney-bean, and of the same shape: but sometimes there are more than two, and then they are less. They are soft and fungous: and their use has been reckoned to be for moistening the Gullet. But Dr. *Wharton* rejects this opinion, because there appears no excretory vessel that might convey the liquor that is separated in them, to within the Gullet. However though such vessel do not appear, yet it is more probable that they serve for that use, than for that which he assigns to them, *viz.* to draw out from the *lymphæ* that runs through them, that juice which is more mild and fit for nourishment, for the use of the Nerves that are fastned to them; or to deposite the remainder into the common chyloferous duct by a pipe which he supposeth there must be, but does not describe.

Use.

The Gullet serveth as a funnel to convey meat and drink into the Stomach; for it receiveth them by dilating its proper internal coat, and turneth them down by the constriction of the middle coat, and the Muscles of the *Pharynx*. But concerning its action, and in what manner, and by what help swallowing is performed, see more fully and particularly in the fifth Book, Of the Muscles, chap. 12.

CHAP.

C H A P. VII.

Of the Ventriculus or Stomach.

THAT part which we term *the Stomach* in English, in Latin is called *Ventriculus*, without any addition, to distinguish it from the other Ventricles, which have always some other word added to determine the signification, as *ventriculus cordis*, *ventriculus cerebri*. In Greek it is called *σῆξ*, and *κοιλία* (from its cavity) as also *καρδία*, which last name is given chiefly to its upper orifice, which has a notable consent with the Heart from their community of Nerves, (both being supplied by the *par vagum* :) and hence a pain here, is called *Cardiaca passio*.

In man it is but *one*; but such Quadrupeds as chew the Cud, especially all that are horned, have *four* Stomachs; the first whereof is called *μεγάλη κοιλία*, in English the *Paunch*; the second *κακρύφαλον*, in Latin *reticulus*; the third *ἐξυόν*, *omasus*, in English the *Feck*; the fourth *ἄνυστρον*, *abomasus*, in English the *Read*. Such Fowl also as live upon Corn have *two* Stomachs; the first membranous, called *ingluvies*, the *crop*; the second carnos, called *ventriculus carnosus*, in English the *Gizzard*. Betwixt these two some name a third called *echinus*, but it seems rather a passage onely betwixt these two than it self a distinct one. But this is not a place to be particular as to the differences of number or shape, &c. of the Stomachs of several Animals, having designed onely a succinct Anatomy of Man. But the inquisitive may satisfy themselves in the learned

Dr. Charleton's second Prelection before the College of Physicians, entituled *Historia Ventriculi*; or more fully in the ingenious Dr. Grew's *comparative Anatomy of Stomachs and Guts*, published with his *Museum Regalis Societatis*.

Situation. It is seated immediately under the Midriff, which it toucheth; chiefly by its two orifices: wherefore if it be too full it causeth a difficulty of breathing, by hindring the motion of it. In the forepart on the right side, it is covered with the hollow part of the Liver; on the left side it is touched by the Spleen; towards the Back, by the *aorta* and *vena cava*; and under it backwards by the *Pancreas*, and more forwards by the *Colon*, all which further its heat.

Bigness. The *bigness* of it is commonly such, as is capable to receive so much food at one time, as is sufficient for nutrition. When it is emptied, Dr. Glisson says, that it hardly weighs an hundredth part of the whole body; so that 'tis a wonder so small a part should cook for the whole. It is less in humane bodies than in Brutes, considering the proportion of their bodies. It is commonly less in Women than in Men. They who have wide Mouths, have large Stomachs.

Figure. It is longish and pretty round, resembling a bagpipe very much in shape. It hangs cross the Body; and its two orifices, by which the meat is received in from the Gullet; and let out into the Guts, stand higher up than its middle, so that its upper part makes as it were the concave of an half-moon. It is more capacious on the left side than on the right.

Connexion. It is joyned with the *gula* on the left side, where its upper orifice is; and it is continued to the *duodenum* on the right side, where its lower orifice is.

is. The bottom in the whole length of it is joy-
ned to the upper part of the Caul, by whose
mediation it is joyned to the Liver, Back, Spleen,
Colon and *Pancreas*.

The *substance* of it is membranous, that it might *Substance*.
admit distention and contraction. It consists of
three *Membranes*. The *first* or out-most is *com-*
mon to it and the Gullet, and is derived from the
Peritonæum. But yet it is not wholly derived
from thence: For as Dr. *Glisson* argues, Seeing
this coat is fibrous, and the *Peritonæum* is not; its
fibres cannot be owing to that, seeing *Nilil dat*
quod non habet. These fibres (being nervous) are
streight, running from one orifice to the other,
and encompassing both its bottom and sides in
their whole longitude. Near the orifices and
towards the bottom of the Stomach, they are
far thicker than in the middle, insomuch as there
they seem in a manner carnous and motory.
They cross at right angles the carnous ones lying
next under them, as serving not onely to cover
them, but to bind them fast, and to hinder them
from starting out of their ranks.

The *second* or middle coat is *proper* and fleshy,
and consists of two ranks of fleshy fibres (with a
Parenchyma.) The outer rank are the more nu-
merous, and are *transverse*, running cross or round
the Stomach; and under these lie another rank,
which (as Dr. *Willis* affirms) upon the top of the
Stomach run streight from the left orifice to the
right; but the remainder of them tend along
each side of the Stomach obliquely forwards to-
ward the bottom, and meet one another there.

The *third* or inmost is likewise *proper*, but is
nervous. On its inner superficies it is lined with

a downy substance, (as the inmost of the Gullet also is) something like Velvet, which appears very plainly after a light boiling of the Stomach. Dr. *Willis* thinks this downy crust to be a distinct coat from the Nervous, because after dipping the Stomach in hot water, it may be easily separated from it: And when it is so separated, because on its outer superficies, which adheres to the Nervous coat, it is beset with abundance of ring-like glands, he calls it the *glandulous* coat. When this is removed, the truly Nervous coat appears, which is endued with all sorts of fibres, but the streight are most numerous. There run abundance of blood-vessels along it, which terminate in its inner superficies that adheres to the glandulous coat. So that, 'tis probable the mouths of the Arteries may disgorge somewhat into the Stomach through the glands in which they terminate.

Besides these Membranes with their Fibres the Stomach hath also a *parenchyma*, especially its middle coat: but it is not sanguineous, but of a peculiar sort. That it has a *parenchyma* is plain; for without one how should the inequalities, that spring from the texture of the Fibres, be filled up? And what should that be, which those that make strings for musical Instruments, scrape from the Guts, if not it? for we see after such scraping they have lost nothing of their strength, which they owe to the Fibres and Membranes. And 'tis apparent that the substance of the Guts and Stomach is the same. Some think this *parenchyma* to be almost wholly glandulous.

Orifices.

It hath two *Orifices*. Of which the *first* is on the left side, and is called the *upper*; not because it is situated higher than the other; but because the meat enters into the Stomach by it, as it goes out

our by the other which is therefore called the *lower*. This is wider than the other, because the meat is onely grossly broken by chewing when it passes through it, whereas it is dissolved into a liquor (called Chyle) when it passes out by the other. It is called in Greek *καρδια*, *cor*, from whence the region of the Stomach under the *cartilago ensiformis* is called *scrobiculus cordis*, or Heart-pit; and hence also the pains which happen in it are called *καρδιαλγια*, and *καρδιαγμοι*, because there is a great consent between it and the Heart, by reason that they both of them derive their Nerves from the eighth pair; so that one being affected primarily, the other must suffer by consent. It hath orbicular Fibres, that the meat and drink being once received within the capacity of the Stomach, it might be exactly shut, lest fumes and the heat should break out to the hindrance of concoction, and annoyance of the Head.

The *other* is seated on the right side, and by the Greeks is called *πύλωρ*, *janitor*, or door-keeper, because, as a *Porter*, it makes way for the *Chyle* to descend to the *duodenum*. Here the inmost nervous Coat is very full of wrinkles; and the middle, which is carnous, as every where else, so here also hath two ranks of Fibres; first transverse or anular, to straiten this passage or shut it upon occasion; and secondly streight, *viz.* such as running lengthways do gather up and draw the rest of the Stomach towards this door, for the distribution of the Chyle after it has been sufficiently concocted in the Stomach. And on the contrary, when these Fibres begin to be contracted at the other end, they often draw the *pylorus* towards the left orifice, as in Vomiting:

And when the convulsion is continued further, the *Duodenum* is drawn upwards, and thence the choler and pancreatick juice are pumpt up as it were into the Stomach. The beginning of the *Pylorus*, where its coats are thickest, Dr. *Willis* calls it *antrum*.

Veins.

It hath *Veins*, first immediately from the trunk it self of *vena portæ*, and this is *pyloricus ramus*; secondly, from the branches of the same, and so from the *ramus splenicus* thereof it hath *gastrica minor*, and *gastrica major* (the largest Vein of the Stomach) from whence *coronaria* springeth; *gastro-epiplois sinistra* and *vas breve*: and from the *ramus mesentericus*, before it be divided, it hath *gastro-epiplois dextra*. All these Veins, (as the rest of the Body) serve onely to convey back again (towards the Heart) the remains of the arterial Bloud which in the circulation is not spent on the refectiion and nourishment of the part; though some learned modern Anatomists think, that besides the arterial Bloud they receive some of the more subtile part of the Chyle for its readier conveyance into the mass of Bloud, and thence draw a reason of the very quick refreshment that hungry and faint persons receive by eating or drinking.

Arteries.

It hath its *Arteries* from *ramus celiacus*, which do accompany every Vein, and have the same denomination with them. Most Anatomists are now of opinion that these Arteries do not onely convey bloud to the Stomach for its nourishment, and for its warmth to help its concoction; but that they empty out of themselves through the glands of the Stomach a certain spirituuous liquor into its cavity, which being joined with the reliques of the Chyle that stick in its downy coat, make that juice which is called the *ferment* of the Stomach, which contributes more to the dissolving the

the

thealiments than the *beat* of it, which the Ancients made the main instrument of its action.

It hath *Nerves* from the *par vagum*, Dr. Willis's *Nerves*. eighth pair) whose trunks passing down (below the pneumonick branches) by the sides of the Gullet, are each divided into *two branches*, the *outer* and *inner*. Both the *inner branches* by and by bending to one another grow into one, which passing with the Gullet through the Midriff goes on the *outside* of the orifice of the Stomach, and spreads it self in its bottom. The *two outer branches* in like manner inclining to each other unite into one, which descending to the Stomach by the *oesophagus*, and arriving at the *inner side* of its orifice, there turns back and creeps through its *upper part*. The *inner* and *outer branches* as they come one on one side, and another on the other side of the upper orifice of the Stomach, send forth many small twigs, which mutually inosculating make there a net-like *plexus*. From this *multitude* of Nerves interwoven in the mouth of the Stomach proceeds that great consent betwixt it and the Head. (So that in any great concussion of the Head there follows a vomiting, and from the foulness of the Stomach the Head-ach, &c.) Here at this upper orifice, from the same reason, is the sense of hunger most urgent.

There are also some *Venæ lacteæ* which spring *Venæ* out of the bottom of the Stomach, whose passage *lactææ* from thence to the Common Receptacle we described before in chap. 5. from Dr. Wharton.

Now as to the cause of *Hunger*, omitting sundry *The cause* opinions about it, I shall give but that one reason *of hunger*. of it which *Diemerbroeck* thinks the most probable, and thus expresses: "It is caused from fermentaceous (or dissolving) particles partaking of

“acrimony, bred of spittle swallow’d and other
 “faltish or acid things eat or drunk, which stick-
 “ing to the coats of the Stomach, and brought to
 “some acidity by it, or remaining in it after the
 “Chyle is sent off, affix’d to its inmost wrinkled
 “Membrane (especially about its upper orifice)
 “molest it by their twitching, which twitching
 “being communicated to the Brain by the Nerves
 “of the eighth pair, an imagination of taking
 “meat is excited to assuage that troublesome cor-
 “rosion.] He that doubts of the truth of this
 opinion, may find it evinc’d at large in his *Ana-*
tome corporis humani, cap. 6. p. 39, &c.

Its action.
Chylus.

The *action* of the Stomach is *Chylification*. Now
Chyle is a pretty thick white juice like Barley-
 cream, made out of the aliments taken ; the
 manner whereof is well exprest by the same Au-
 thour. “While the meat is chewing in the Mouth,
 “it is mix’d with the *saliva*, which not onely sof-
 “tens it, but endows it with a certain fermenta-
 “tive quality, unto which contributes also the
 “drink, (whether Beer, or Wine or some other)
 “which often contains in it acrimonious particles
 “and fermentaceous spirits. The Stomach by
 “the help of its fibres embraceth closely the meat
 “thus chew’d and swallow’d, and mixeth there-
 “with specifick fermentaceous juices, bred in its
 “inner coat, and impregnated with the *saliva*.
 “Then by a convenient heat there is made a
 “mixture and eliquation of all ; for that the fer-
 “mentaceous particles entring into the pores of
 “the meat, do pass through, agitate and eliquate
 “its particles, dissolving the purer from the crass,
 “and making them more fluid, so that they make
 “another form of mixture, and unite among
 “themselves into the resemblance of a milky
 “cream ;

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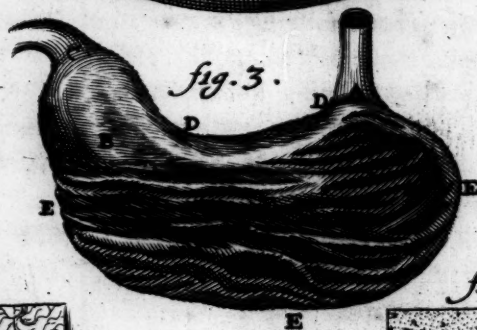
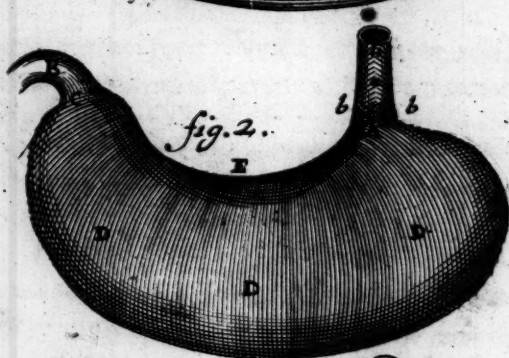


fig. 4.

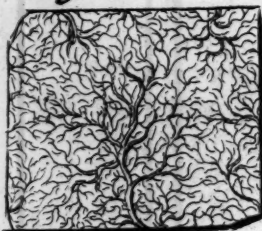
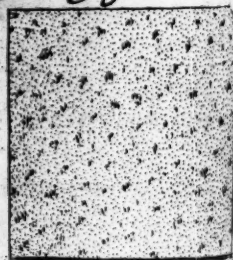


fig. 5.



VII. *Of the Stomach.*

41

n; after which, together with the thicker, with which they are as yet involv'd, by constriction of the Stomach they pass down the Guts, where by the mixture of the bile and the pancreatick juice, they are by another manner of fermentation quite separated from the thicker mass, and so are received by the small vessels, as the thicker is ejected by stool.] further hereof in Dr. Charleton's third prelection before the College of Physicians, Sect. 6. p. 112.

II. *Representeth the several Coats of the Stomach with their Fibres, from Dr. Willis.*

1. expresses the outmost nervous coat of the stomach, whose nervous fibres running lengthways of it, cut the outer carnos ones that lie under them, at almost right angles.

The Gullet, in whose outer coat all the nervous fibres descend streight, crossing obliquely the carnos ones that lie under them.

The mouth of the Stomach.

The Pylorus with its antrum D, and a portion of the Duodenum continued from it E.

The upper part of the Stomach, where the blood-vessels appear very numerous.

G The nervous and slender fibres running lengthways of the Stomach from one orifice to another, and further each way.

2. shews the Stomach divested of its outmost nervous coat, that the outer or convex superficies of the middle coat with its carnos fibres may appear.

The mouth of the Stomach into which the Gullet
aaa is

pag. 42.

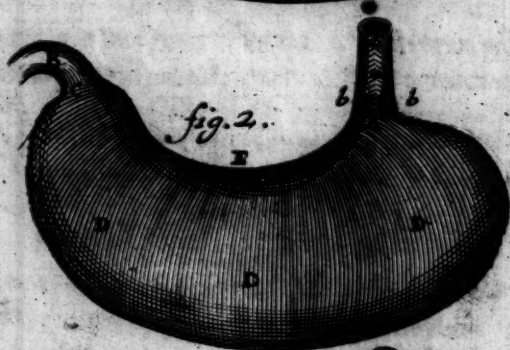
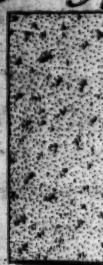
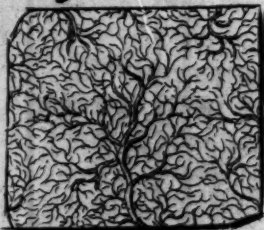


fig. 4.



"cream; after which, together with the thicker
 "mass, with which they are as yet invol'd, by
 "the constriction of the Stomach they pass down
 "to the Guts, where by the mixture of the bile
 "and the pancreatick juice, they are by another
 "manner of fermentation quite separated from
 "the thicker mass, and so are received by the
 "lacteal vessels, as the thicker is ejected by stool.]
 See farther hereof in Dr. Charleton's third prelec-
 tion before the College of Physicians, *Seet. 6. p. 112.*

Tab. II. *Representeth the several Coats of the Sto-
 mach with their Fibres, from Dr. Willis.*

Fig. 1. *expresses the outmost nervous coat of the
 Stomach, whose nervous fibres running length-
 ways of it, cut the outer carnos ones that
 lie under them, at almost right angles.*

A *The Gullet, in whose outer coat all the nervous
 fibres descend streight, crossing obliquely the car-
 nous ones that lie under them.*

B *The mouth of the Stomach.*

C *The Pylorus with its antrum D, and a portion
 of the Duodenum continued from it E.*

F *The upper part of the Stomach, where the bloud-
 vessels appear very numerous.*

GGG *The nervous and slender fibres running length-
 ways of the Stomach from one orifice to another,
 and further each way.*

Fig. 2, *shews the Stomach devested of its outmost
 nervous coat, that the outer or convex super-
 ficies of the middle coat with its carnos fibres
 may appear.*

A *The mouth of the Stomach into which the Gullet
 aaa is*

aaa is inserted, and which the circular carnous fibres bbb encompass, shutting it upon occasion by contracting themselves.

B The Pylorus with the Duodenum continued to it.

C The orifice and antrum of the Pylorus, both which, the circular fibres, when they are contracted, straiten, and seem to shut.

DDD The circular fibres encompassing the Stomach depthways.

EEE The top of the Stomach, where these fibres spring, whilst they are contracted draw towards it the whole bulk of the Stomach very much straitned.

Fig. 3. shews the Stomach turn'd inside outward, that the downy crust with the wrinkles and folds may be seen.

A The left orifice of the Stomach.

B The antrum of the Pylorus, in which the coats are thicker.

C The right orifice to which the Duodenum is continued.

DD The top of the Stomach betwixt the two orifices.

EEEE Its sides, end and bottom, in which the downy crust of the inmost coat, with the wrinkles and furrows therein, are exprest to the life.

Fig. 4. represents a piece of the nervous coat, in which, the downy crust being removed, its inner or concave superficies appears, with a very thick branching of vessels.

Fig. 5. shews a piece of the downy or glandulous coat, in which its outer superficies, that cleaves to the nervous coat, appears very full of glandules and the mouths of vessels.

C H A P. VIII.

Of the Intestines, or Guts.

THE Guts are called in Latin *Intestina*, in The Guts.
Greek *Ἐντέρας*, and *Ἰστέρας*, from their being Their
placed within the Body. Name.

They are oblong, membranous, hollow, round, Figure.
diversly twisted, continued from the *pylorus* to
the *podex*, for conveying the Chyle, and the ex-
crements of the first concoction.

They are knit together by the Mesentery, by Connexi-
which and by the intervention of the Caul (to on.
which, part of the *Duodenum* and of the Colon is
affix'd) they are tied to the back, and fill the
greater part of the Cavity of the *Abdomen*.

They are of a membranous *substance* like the Substance.
Stomach, thinner in the small Guts and thicker
in the great; and the nearer they come to an end,
the thicker they are, as the lower end of the Co-
lon, and the *Rectum*.

The *length* of the Guts is about six times the Length.
partie's length whose they are. They are thus long
(and winding) that the concocted aliments pas-
sing out of the Stomach, by their long stay in the
Guts, might the more commodiously be ferment-
ed by the admixture of the bile and pancreatick
juice, and so the more subtil chylous parts being
separated from the thicker mass, might be the
better and more leisurely driven into the narrow
orifices of the lacteal Vessels, partly by the pro-
per peristaltick motion of the Guts, and also by the
impulsion of the Muscles of the *Abdomen* moved
in

in respiration. And hereby two great inconveniencies are avoided ; the one of eating almost continually, which would have follow'd from the Chyle's having not time enough to be elaborated and distributed, before it would have arrived at the *anus*, whereby the Body must needs receive but small sustenance from any thing eat or drunk ; the other (for the same reason also) of having almost a continual need of going to stool ; as happens to such voracious animals as have a freighter passage from the Stomach to the *anus*.

Coats.

They have three *Coats* like the Stomach. The *outmost* is *common*, and is derived from the *Peritonæum*, but mediately ; for in the *Duodenum*, and that part of the *Colon* which runneth under the Stomach, it proceedeth immediately from the membranes of the *Caul*, which is knit to those Guts ; and in the *Jejunum*, *Ileum*, the rest of the *Colon*, the *Cæcum* and *Rectum*, it proceedeth from the membranes of the *Mesentery*. It is all over besmear'd with fat, and is truly nervous.

The other two *Coats* are *proper*. The outer of them being the *middle* of the three, is carnosus. It has two ranks of moving Fibres, one lying under the other ; The first and inner rank is annular or transverse, which encompassing the whole cavity of all the Intestines in very close order, is inserted into the hem or seam of the *Mesentery* as into its Tendon. The other rank is of freight Fibres, which being spread above the former, and cutting them at right angles, reach along the whole length of the Intestines ; and their Tendon seems to be the outmost coat, which being wholly nervous, or as it were tendinous, is wrapt about the whole rank of these Fibres.

The *innermost* is nervous, although it seem to be

be fleshy, by reason of the crusty substance with which it is lined. This lining is called by *Pecquet* a spongy *peristoma*, by *Bilsius* a woolly *moß*; it serves as a Filtre for the Chyle to transcolate through in order to its entrance into the *venæ lacteæ*; and besides, it hindreth excoriation, which might be caused when sharp humours pass through the Guts. Some (as particularly *Dr. Willis*) take it for a distinct coat, and call it *glandulosa tunica* or *villosa*; being altogether like that of the Stomach, which is described in the foregoing Chapter, and having the same use with it.

This Membrane in the small Guts, especially the *Ileum*, is full of wrinkles, to stay the Chyle from passing too soon; which wrinkles are caused, for that this inmost coat if it be sever'd from the former and the wrinkles stretcht open, will be (according to *Fallopian's* observation) thrice as long as it. And the same Membrane is expanded in the *Colon* into little cells, for the slower passing of the *fæces*. These wrinkles in both are called by * *Kerkringius*, *val-vulæ conniventes*. It * *Kerckr.* has all sorts of Fibres, and contains the mouths *obs. Anat.* of all the Vessels both sanguineous and lacteal, *xxxix.* which are cover'd with that spongy crust before-*p. 85.* mentioned.

What was said of the *Parenchyma* of the Stomach in the foregoing Chapter, may without repeating it here, be applied to the Guts likewise.

Many late Anatomists have observed abundance of *Glands* to stick in this inmost coat, (besides those which make *Dr. Willis's* glandulous coat) but they have been treated of by none, I think, so exactly as by *Peyerus*, who has writ a small tract of them, and describes them thus. "They cannot be seen, *he says*, on the outside, " but

" but if one slit open the Gut lengthways, and
 " thrusting his finger against the outside, press
 " the inside out by the slit, and hold it to the
 " light, they plainly appear like little teats, with
 " each one a small pore in its top towards the ca-
 " vity of the Gut, as their bases or backsides have
 " blood-vessels (and, as he says, Nerves too)
 " inserted into them. If one press with his finger
 " on their backside, there will issue out of their
 " pore a clammy humour. There are but very
 " few (sometimes none) of them in the *Duodenum*
 " or *Jejunum*, but they are most numerous in the
 " *Ileum*, especially towards its lower end, and
 " they are onely on that side of the Gut that is
 " opposite to the adhesion of the Mesentery.
 " Where they are, they are not single, but a knot
 " of them together, whence he reckons them in
 " the number of *conglomerate* glands. They are
 " thus in knots in the small Guts; but in the
 " *Cæcum*, *Colon* and *Rectum* they stand single, but
 " are larger than the other, with every one a
 " pore in it likewise. These are almost as big as
 " a Vetch (and of the same shape) but those in
 " the small Guts are but about the bigness of Mil-
 " let. He thinks their office is to separate a dou-
 " ble sort of liquor, *viz.* a subviscid and glutinous
 " *serum* from the Arteries, and a nitro-aereous
 " spirit from the Nerves; which two being mixt
 " together make a fermentative liquor for the
 " perfecting of chylification in the Intestines. This
 " is their use chiefly in the small Guts: but in the
 " thick ones *he says* they afford a clammy hu-
 " mour, by means whereof the Guts are fenced
 " against the hardness of the excrements, &c. and
 " also the particles of the excrements themselves
 " are hereby glued together, as it were, into a due
 " consistence.] Thus he.

As

As to their *Vessels*, the *Veins* spring from the *Veins* *Porta*, but not all of them from the same branch: For the *duodenalis furculus* is sent into the *Duodenum*, and the *Hæmorrhoidalis interna* to the left part of the *Colon* near its ending, which running downwards from thence under the *Rectum* is inserted into its end or *anus*; as the *dexter mesentericus* is sent to the *Jejunum*, *Ileum*, *Cæcum*, and the right part of the *Colon*. *Epiplœis postica* is inserted into the middle part of the *Colon*, which marcheth across under the *Stomach*. Besides these, a sprig from the *ramus hypogastrius* of the *Vena cava* is sent to the *Muscles* of the *intestinum Rectum*, which maketh the external *hæmorrhoidal*.

The use of these *Veins* inserted into the *Intestines* *Their use.* the *Ancients* thought to be, both to carry venal blood to them for their nourishment, and also to receive the *Chyle* out of them and carry it to the *Liver* there to be turn'd into blood. As to the first use, 'tis certain (by the circulation of the blood) that these *Veins* carry nothing to the *Guts*; but the blood that is in them, is all received from the *Arteries* there, to be carried back towards the *Liver* and so to the *Heart*: but as to the latter, there are some learned *Anatomists* that still think, though the greatest part of the *Chyle* is received by the *venæ lactææ*, yet that some part is suckt in by these *Veins*, that it may be more readily convey'd into the mass of blood. But this opinion is exploded by others as learned and more numerous, who deny any such office to them, to whom I subscribe.

Besides these sanguineous *Veins* there are another sort of *Veins* inserted (more or fewer) into all the *Guts*, called *Lacteal*, but of them we will treat in a distinct Chapter.

The

Arteries. The *Arteries* spring partly from *ramus celiacus intestinalis*, partly from both the *mesentericæ*. To the *Duodenum* and the beginning of *Jejunum*, a sprig is sent from the right *ramus celiacus*: but to the rest of the *Jejunum*, to *Ileum*, *Cæcum* and the right part of *Colon*, *mesentericus superior*; to the left part of *Colon*, and to the *intestinum Rectum*, *mesentericus inferior*. This last, passing along the *Rectum* to the *podex*, makes the *internal hæmorrhoidal Arterie*, as some branches from the *arteria hypogastrica* make the *external*. Lastly, *epiplois postica*, which riseth from the lower part of *arteria splenica*, (which is the left branch of *arteria celiaca*) is sent to the middle part of the *Colon*, which lieth under the *Stomach*.

Their use. Their use is to convey nourishment and warmth to the Guts; and when the Body is morbose, to carry thither the impurities of the blood, upon a purge taken, or critically, so to pass out by stool. Yea 'tis very probable, according to *Peyerus* his opinion before cited, that such *Arteries* as terminate in the glands above described, do spue out through them into the Guts, even in a healthfull state, that slimy humour that bedaubes the inside of them, for the more glib descent of the *feces*: but whether they do also discharge through them a fermentative liquor, I think is more doubtful.

Nerves. *Nerves* they have from the inferiour ramifications of the *Intercostal* or ninth pair. The *Duodenum* hath some twigs from the upper branch of the *ramus mesentericus* called *stomachicus*, which go also to the *Pylorus*. All except the *Rectum* have many twigs from the *plexus mesentericus maximus*, arising from under the great gland of the *Mesentery*; but the *Rectum*, with the lower end

end of the Colon receive slips from the *plexus abdominalis infimus* or *minimus*; and the utmost extremity of the Intercostal is inserted into the *sphincter ani*, whither also pass three or four that spring from the bottom of *os sacrum*.

These Nerves serve for the feeling, and for ^{The peristaltick} the peristaltick or worm-like motion, of the Guts; ^{motion.} which though it be obscure and slow, yet because it is continual, it had need of so great a number of Nerves or nervous Fibres as are bestowed on the Intestines. Now this motion is in some measure performed by the oblique fibres, but especially by the transverse, whereby what is contained in them is driven from above downwards: unless it happen that the motion be inverted, as in the Iliack passion, in which they drive their Contents from below upwards. But the learned and curious that would be farther informed about the peristaltick motion, may consult Dr. Glisson in cap. 15. of his Book *de ventriculo & intestinis*, or Dr. Charleton in Sect. 3. of his third prelection before the College of Physicians. As for that other use, which Peyerus ascribes to the Nerves, of transmitting a nitro-aereous spirit through the Glands into the Guts, which mixing with that humour that is separated from the Arteries makes a ferment for the perfecting of chylication in the Intestines, the Reader is at his discretion what opinion he will entertain of it.

Though the Guts be one continued Body from ^{The division} the pylorus to the anus, yet from the thickness of ^{on of the} their substance, as also from their magnitude, figure, and variety of office they are distinguished into several by Anatomists, and first into *thin*, and *thick* Guts.

The differences between the *thin* and *thick*
E Guts

Guts are thus summ'd up by *Aquapendent* : "The
 " *thin* or *small* are placed above, are long, equal,
 " round, rolled about in wreaths, full of wrin-
 " kles, interwoven with innumerable Veins, and
 " Chyle is found in them : On the contrary, the
 " *thick* are placed below, are short, anfractuous,
 " without twisting wreaths, and endued with
 " fewer Veins ; and the wrinkles or folds in the
 " Guts are expanded, and there result from them
 " certain recesses or cells, and the *faces* are found
 " in them.

The thin.

The *thin* possess the umbilical region and *hypo-
 gastrium* ; and in respect of their figure, situation,
 longitude and plenty of lacteal Vessels, they are
 divided into three, *viz.* the *Duodenum*, *Jeju-
 num* and *Ileon*.

1. Duode-
 num.

The first is called *Duodenum*, because the An-
 cients thought it to be twelve inches long. But
 being chiefly vers'd in the dissection of Brutes, they
 were thereby deceived ; for though in Sheep,
 for instance, it be of that length, yet in Man it is
 but about four fingers. It is continued from the *py-
 lorus*, from whence turning backwards and down-
 wards it reaches to the middle of the greater and
 right end of the *Pancreas* ; and is none of it knit
 to the Mesentery, but to the membrane of the
 Caul. It is thicker in its Membranes than the
 two following small Guts, but its passage (because
 freight) is straiter than theirs. Towards its
 lower end, (sometimes higher, sometimes lower)
 it has most commonly two ducts leading oblique-
 ly into it ; first the *ductus choledochus communis*,
 by which the bile from the Liver enters this Gut ;
 and secondly a little below this, *ductus pancreati-
 cus* (otherwise *Wirtfungianus*) by which the pan-
 creatick juice passes hither from the *Pancreas* or
 Sweet-

Sweet-bread ; though these two ducts are sometimes joined into one, and both open by one mouth into this Intestine.

The second is called *Jejunum*, or the hungry Gut, ^{2. Jejunum.} because it is for the most part found empty ; partly by reason of the multitude of milky Veins that enter it ; partly by reason of the fermentation of the acrimonious choler with the pancreatick juice, which are both poured in just before its beginning. In length it is about eight feet. It beginneth on the right side, under the *Colon*, where the *Duodenum* endeth, and the Guts begin to be wreathed ; and filling a good part of the umbilical region, especially on the left side, it is continued unto the *Ileum*, from which it may be distinguished first by its emptiness ; secondly, by its greater number of Veins and Arteries, from which it looks reddish ; thirdly, from the nearness of the folds or wrinkles of its inmost coat one to another, which are but about half an inch distant, whereas in the *Ileum* they are a whole inch or more ; and lastly, from the thickness of its coats, as being thicker than those of the *Ileum*.

The third is called *Ileum*, ἀπὸ τοῦ ἐλκεῖναι, a circumvolundo, ^{3. Ileum.} from its many turnings and windings. It hath thinner membranes than the two before-going. It is seated under the Navel, and filleth both the *Ilia*. It is the longest of all the Guts, for in length it containeth above twenty feet ; but it is the narrowest of all, for it is but about a fingers breadth in diameter. It hath fewer wrinkles than the *Jejunum*, and lesser ; about the lower end of it they scarcely appear.

At its beginning it is distinguished from the *Jejunum* by all the four particulars above-mentioned ;

tioned; and it is easily distinguishable from the *Colon*, being not join'd to it by a streight duct but transverse. For the *Colon* and *Cæcum* are so united, as to make one continued canal, whose lower side the *Ileon* ascending pierceth, and into which its inner coat hangs loosely the length of half an inch at least, making the valve it self of the *Colon*, and is the limit that divides the *Cæcum* from it.

This *Ileum* oft falls down into the Cod, whence such a rupture is called Intestinal. And in this Gut happens the distemper called *Volvulus* or *Iliaca passio*, wherein there is often vomiting of the dungy excrement. This distemper is caused herein, either when one part intrudes into another, or when the Gut is twisted and twined like a Rope, or when it is stufft with some matter that obstructs it, or lastly when it falls out of its place into the *scrotum*, as was noted before. And thus much of the first sort of Intestines, viz. the *small* or *thin*.

The thick
Guts.
1. *Cæcum*.

Now follow the *intestina crassa*, the *thick* or great Guts; they are three in number also.

The first is called *Cæcum*, *ωαδον*, the *blind* Gut, because one end of it is shut, so that the *Chyle* (or *feces* rather) both goes in and comes out at the same orifice. In Man it is about as thick, and but half as long, as your larger earth-worms stretched out at length; onely its mouth that opens towards the *Colon* is pretty large. It owes its origine rather to the *Colon* than the *Ileum*, and seems to be as it were an appendage to it. It is bigger in an Infant than in a Man. It is not tied to the Mesentery, but being placed in the cavity of the right *os Ileum* by its end it is joyned to the right Kidney, the *peritonæum* coming between. In sound persons it is generally empty. In four-foot-
ed

ed Beasts it is always full of excrements. Apes have it larger than a Man, Dogs larger than Apes; but Conies, Squirrels and Rats, largest of all, if you consider the proportion of their Bodies. Its use is very obscure in Men, being so very small and commonly empty. But in grown *fetus's*, or Infants new born, it is full of excrement, for which it serves as a store-house till after the birth that they go to stool. And in such Animals as have it large, (according to Dr. *Glisson*) it serves for a bag or second Ventricle, wherein the prepared aliments may be stored up and so long retained, till a richer, thicker and more nutritive juice may be drawn from them.

The second is Colon, *κῶλον*, either *quasi κῶλον* 2. Colon. *caevum*, because it is the *hollowest* or widest of the Guts; or else *ἀπὸ τῆς κωλύειν*, *ab impediendo*, because it *detaineth* the excrements. It hath its beginning at the *os Ileum* on the right side, and ascending by its Spine it arrives at the right Kidney; to which parts it is annex'd by a membranous connexion. From thence bending left-ways it creeps under the Liver by the Gall-bladder (which tinges it there a little yellowish) to the bottom of the Stomach, to the whole length whereof it is tied by the mediation of the fore Leaf of the Caul, as it is knit also to the *Pancreas* and Loins by the mediation of the hinder Leaf. Then it comes to the lower part of the Spleen, and is knit to it. Then touching the left Kidney, and adhering firmly to it by Fibres, it comes to the left *os Ileum*; from which descending by the left Groin to the *pelvis*, it embraceth the bottom of the bladder behind on each side. Afterwards it ascends upwards by the right Groin near the place from whence it first took its rise; and thence

E 3

marching

marching back again towards the left side, and running it self in betwixt the *Ileum* and Backbone, it reaches to the top of *os Sacrum*, and there unloads it self into the *Rectum*. Its length according to Dr. *Glisson* is about seven feet ; others reckon it shorter. It goeth almost quite about the *abdomen*, next to the Muscles, that it may be the better compressed by them for avoidance of the excrements. *Diemerbroeck* has an ingenious reason why it should pass under the Stomach, *viz.* That as Chymists judge no digestion more natural than that which is performed by the heat of dung, so the heat of the excrements in the *Colon* does help the coction of the Stomach.

Its Cells
and Liga-
ments.

It hath *Cells* which spring from the internal Tunicle of it : these Cells are kept in their figure by a *Ligament* half an inch broad, which passeth through the upper and middle part of this Gut all along ; this being broken or dissolved, the Cells stretch out and appear no more. Their use is to hinder the flowing of the excrements into one place, which would compress the parts adjacent ; as also for the slower passage of the *faces*, that we may not have a continual and hasty need of going to stool. On its outside, especially from its passing by the Spleen to its joyning to the *Rectum*, it has a great many fatty knots, which serve to moisten and lubricate it, that the *faces* may pass the more glibly. The *Rectum* also has such like, for the same reason.

Its valve.

It hath a *Valve* where it is joyned with the *Ileum*, which Valve is nothing else but the inmost coat of the *Ileum* propending or hanging out flaggy into the *Colon*, (as was noted before :) For its shape, *Spigelius* compares it to the *sigmoides* in the right *sinus* of the Heart. This Valve so stoppeth the
hole

hole which is common to the *Ileon* and *Colon*, that flatuosities cannot ascend from this latter into the former, much less excrements regurgitate. But if it be relaxed or torn by any means, excrements may regurgitate, and be cast out by vomit, and Clysters also ascend up to the Stomach, as hath often happened in the *Iliack* passion.

The third is *intestinum Rectum*, the *streight Gut*. 3. Rectum.
This hath its beginning at the first *vertebra* of the *os Sacrum*, where the *Colon* endeth; and passeth streight downwards to the extremity of the *Coccyx*. It is fast tied on its *back-side* to both these bones, by mediation of the *peritonæum*, to keep it from falling out; and on its *fore-side* it grows in *men* to the neck of the Bladder, (whence in the pain of the Stone there, there generally happens a *tenesmus* or continual inclination to go to stool) and in *women* to the neck of the Womb: but in both there is a musculous substance that comes between. It is a foot in length, not so wide as the *Colon*, but its Membranes are thicker.

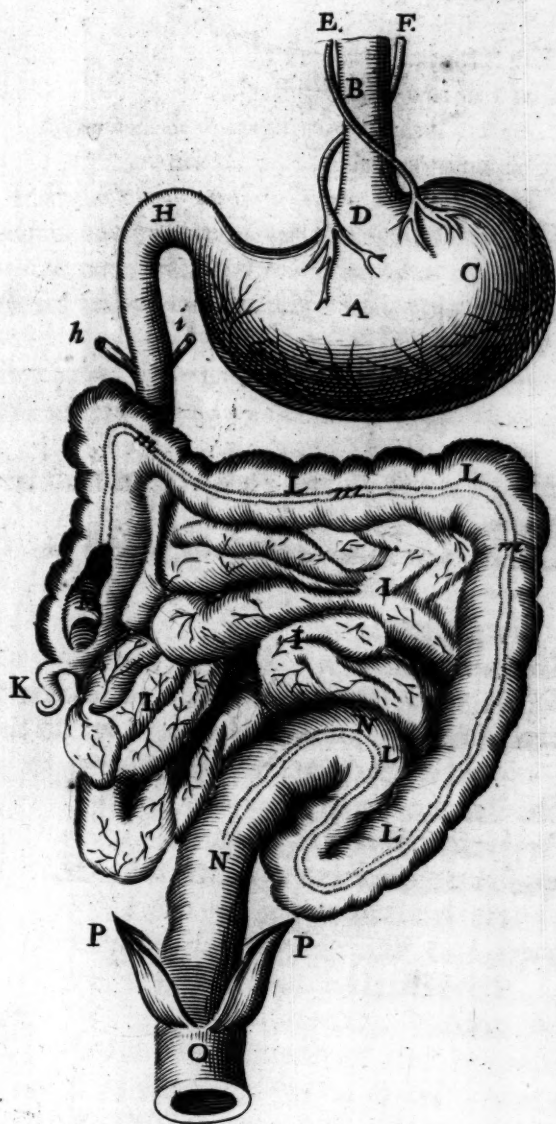
The *Sphincter Muscle* is at the end of it, which *It's Sphincter Muscle.*
encompassing it round, purses it up close, so that nothing can pass out, unless it be relaxed voluntarily.

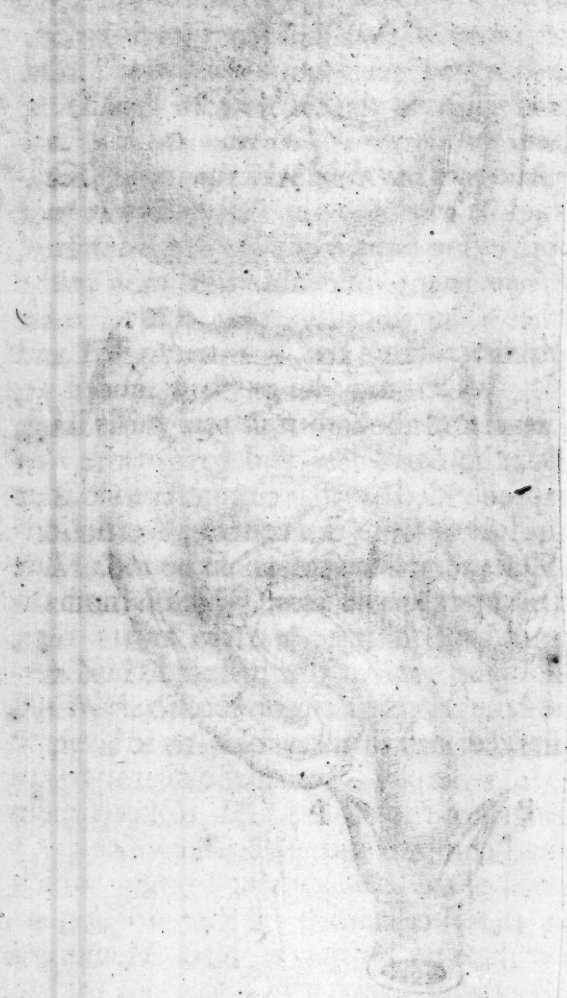
This Gut (especially its inner Membrane) usually bags a little out in straining at stool, yea sometimes so much, that it requires an artificial putting up again.

As for the hemorrhoidal Veins and Arteries, that are inserted into the *anus*, we have given an account of them before in this Chapter; as we shall do of the *Muscles* belonging to it, in Book 5. of the *muscles*, Chap. 19.

The Explication of the Figure,

- A The Stomach.
 B The Gullet or Oesophagus.
 C The left and larger part of the Stomach.
 D The upper orifice of the Stomach.
 E The right external Nerve of the sixth pair
 (Dr. Willis's eighth) encompassing the orifice.
 F The left external Nerve of the same pair.
 GG The gastrick Vessels creeping along the bottom
 of the Stomach.
 H The lower orifice of the Stomach, called pylorus.
 h The insertion of the Gall-passage into the Duode-
 num,
 i The insertion of the Pancreatick duct into the
 same.
 III The Jejunum and Ileum with the Vessels
 creeping along them.
 K The Cæcum.
 LLLL The Colon.
 M The valve in the beginning of the Colon opened,
 mmm The Ligament holding together the Cells of
 the Colon.
 NN The Rectum.
 O The Sphincter of the Anus.
 pp The Muscles called Levatores Ani.





C H A P. IX.

Of the Mesentery.

THE Mesentery is so called from its situation. *The Mesentery.*
 For it has its Greek name *μείσεντερον* (from *its name*
 whence the English is derived) from its being *and de-*
 placed *ἐν μέσῳ τῶν ἐντέρων*, in the midst of the *scription,*
Intestines. And it is a membranous part, situa-
 ted in the middle of the lower Belly, serving not
 onely for conveying some Vessels to the Intestines,
 and others from them, but also ties most of the
 Guts together so artificially, that for all their
 manifold windings they are not entangled and
 confounded. Which may be much wondred at,
 how the Guts being about nine or ten yards long,
 should all but the *Duodenum* and part of the *Rec-*
tum be comprehended by that circumference that
 is but a span distant from the centre; for no lon-
 ger is the Mesentery berwixt those bounds. But
 it is almost of a circular figure, which is most ca-
 pacious; and though it be narrow at its rise,
 (which is double, *viz.* at the first and third *ver-*
tebræ of the Loins) yet its circumference is wrink-
 led and enlarged into so many folds, as to be three
 ells in length, whereby it comes the nearer to an-
 swer the length of the Guts, and to keep them
 within a small compass and place likewise.

It is framed of two *common* Membranes, which *Substance.*
 it has from the duplicature of the *peritonæum*;
 and berwixt these two it has a third Membrane
 that is *proper*, (which was first discover'd by Dr.
Wharton in a young Maid) and is thicker than
 either of the other two, wherein the glands are
 seated,

seated, and by which the Vessels are conducted.

Parts.

The parts contained in the Mesentery are either common or proper. The *common* are Veins, Arteries, Nerves and Lympheducts. The *proper* are Glands and the *Venæ lacteæ*. Of these last we shall speak in the next Chapter, of the rest here.

Veins.

The *Veins* are called *Mesaraicæ*; these spring from *ramus mesentericus dexter & sinister*, branches of the *vena Portæ*. (Their use, as also that of the Arteries, was shewn in the Chapter before, speaking of the Vessels belonging to the Guts.)

Arteries.

It hath also two *Arteries*, the one superior, the other inferior, branches of the *arteria mesenterica*, which pass as the Veins do.

Nerves.

As for the *Nerves*, Dr *Willis* describeth them very accurately in his Book *de Cerebro*, cap. 25. which taketh thus in short. "As soon as the *intercostal pair* is descended as low as over against the "bottom of the Stomach, it sends forth on each "side a large mesenterick branch, each of which "is again divided and makes two *plexus* in each "side. In the middle of these is the greatest *plexus* of all, which (as he speaks) is like the Sun amongst the Planets; from which, twigs and "numerous Fibres are dispersed into all the parts "of the Mesentery, which accompanying the "sanguiferous Vessels in their whole process, do "climb upon and twist about them." Others it hath from those which spring from the *spinalis medulla*, between the first, second, third and fourth *vertebræ* of the Loins, (as *Spigelius* affirmeth.)

Lympheducts.

Besides these Vessels known to the Ancients, about 31 years agoe there were found out another

other sort by *Tho. Bartholin* (a learned Dane) and called by him *vasa lymphatica*, which he gives a large account of in *Append. 3. to the libel. 1. de Venis*, of which I shall give a *compendium* here, because the Mesentery abounds with them.

They are of figure long and hollow like a Vein, Their si- but very small and knotty, having very many gure. valves which permit the *lymph*a or water contained in them to pass to the chyliiferous Vessels (and many Veins) but hinder its return.

They are of a pellucid and crystallin colour, Colour and like *hydatides*, consisting of a transparent and most Substance. thin skin, which being broken and the *lymph*a flowing out, utterly disappears.

Their number cannot be defin'd, for they are Number. almost innumerable.

As to their rise. *Bartholin* speaks uncertainly, Rise. but *Steno* and *Malpighius* both declare that they always proceed from Glands.

As to their insertion or ending, those under the Insertion. Midriff do discharge their liquor into the *receptaculum chyli* (to be spoken of in the next Chapter.) Those in the *thorax*, immediately into the *thoracick duct*. And those of the Neck, Arms, &c. into the jugular vein. *Bartholin* thought they all discharg'd themselves into these three chanel: but *Diemerbroeck* affirms they open also into many other Veins; and quotes *Steno* noting that they empty themselves into the jugular and other Veins; and also his Countryman *Frederick Ruysch* writing that by ligature and structure of the Valves he has plainly seen, that all the lympheducts in the Lungs do discharge their *lymph*a into the subclavian, axillar and jugular Veins.

There

What the
Lympha
is.

There has been much dispute what this *lympba* which they carry, is. *Bartholin* thinks it to be the simple superfluous *serum* of each part, brought thither by the Arteries. *Glisson*, that it is a liquor condens'd from the *halitus* of the blood (like dew) driven into these Vessels, and flowing back with the vehicle of the aliment brought by the Nerves. *Segerus* (and *Sylvius*) that it is the animal spirits, or is made of them, which after they are distributed into all parts by the Nerves, are there partly consum'd and dissipated, and are partly condens'd into this water. *Diemerbroeck* quotes more opinions besides these, but rejects them all and establisheth this of his own, viz. "That it is a fermentaceous liquor separated from the serous part of the blood in the conglobate Glands, yet not simple, but impregnated with much fus'd and volatile salt, and also with some sulphureous particles; which when it is conveyed to the *vasa chyli*fera, makes the chyle thinner and apt to dilate easily in the Heart; and when to the *Veins*, prepares the venous blood (now too thick) for a quick dilatation in the Heart.] This *lympba*, whatever it be, (or be for) differs from the *serum*; for if one gather a little of it in a spoon, and let it stand, without setting it on the fire, it will turn to a gelly, which the *serum* will not doe.

And thus much of the *Lympheducts* (with their *lympba*) in general; as to those particularly of the Mesentery, some onely pass through it from other parts, as from the Liver, &c. but many have their rise in it, and both the one and other are emptied into the *receptaculum chyli*.

It

It hath many little softish Glands fix'd in its proper Membrane, cover'd on each side by the two common ones, and beset with fat. In number they are very uncertain; in Man fewer than in other Creatures. The biggest by much is at the rise or centre of the Mesentery, (called by *Ase- lius, pancreas*) into which all the *venae lacteae* are inserted. Of its use, as also of the lesser, we shall speak in the next Chapter, when we come to treat of the passage of the Lacteals. We will onely note here, that when these Glands grow scirrhus, or are any ways obstructed, so that the Chyle cannot transcolate through them, there follows a *fluxus celiacus*, or *chylosus*, which continuing, there ensues an Atrophy, and the party dies tabid.

The fat with which it is stufft betwixt its Membranes, though it happen naturally to it, yet ought not to be reputed a proper part of it. For not to mention that in Dogs, Cats, and such like Animals this part is very thin and transparent, even in humane Embryo's it is without fat; and in very lean Men there is but little, though in fat Men it be heaped up to so great a thickness.

It is but one, yet because of its different thickness it is divided by some into two parts.

The one they call *Mesenterium*, *μεσεντεριον*, because it is placed *εν μεσω τῷ ἀραιῷ* (*subaudi εντερον*) in the midst of the small Intestines, which it knits together; and this is the thicker part of it. The other being the thinner they call *μεσocolον*, being seated *εν μεσω τε κώλῳ*, in the midst of the Colon, to which it is joyned in its whole length save onely in the Colon's passage under the Stomach; and in its lowest border it adheres to a part of the *Rectum*.

Diseases

Disenses incident to this part are reckoned up by Dr. Wharton to be these; those of intemperies, flatulens or obstruction, tumours of whatsoever kind, (Scurbi, Scrophulæ, Strumæ) Inflammations, Abscesses, Ulcers, and Tone vitiated. Of all which the Reader that desires fuller information, may be furnished by the said learned Author, in his Adenographia, cap. 11.

C H A P. X.

Of the Venæ lacteæ, Glandulæ lumbaræ, Receptaculum Chyli, ductus chyloferus Thoracicus, and of the motion of the Chyle.

**Venæ
Lactææ.
Their
name.**

V*enæ lactææ*, the *Milky veins* (so called from the white colour of the Chyle which they carry) were not discover'd (as such) till the year 1622. when *Caspar Asellius* found them out in dissecting a Live-dog well fed. But since him many others have made a more accurate discovery of them than he.

**Definitio-
on.**

They are slender pellucid Vessels, having but a single Coar, disperfed in great numbers through the Mesentery, and appointed for the carrying of the Chyle.

Rise.

Their *rise* is from the inmost membrane of the Intestines, where their Mouths are hid under a kind of a spongy crust or *mucus*, through which by the presson of the Guts the Chyle is strained and received by the mouths of these vessels. From whence they proceed the readiest way to such
Glan-

Glandules of the Mesentery as are nearest to them : but in their passage many small ones uniting to one another do commonly grow into one large trunk ; namely, a pretty way before they insinuate themselves into the Gland, to which we said they were going. But in their very entrance into the Glands, or a little before, this trunk separates again into new branches, more and smaller than the other, which are obliterated in the very substance of the Gland. And thus far they are called *radicales*, or *primi generis*, of the first kind. Out of the Gland there spring again new capillary ones, which by and by meeting together make one trunk again as before : these being carried towards the centre of the Mesentery, in their march joyn themselves to others of the same kind that meet them, and so growing larger and larger, at last most of them enter into the great or middle Gland of the Mesentery (called improperly *Pancreas*) in the same manner as they enter'd the smaller, but some pass over its *superficies*, and by and by they all empty themselves into the great or common receptacle of the Chyle, that lies under the said Gland, those that were inserted into it rising out of it in like manner as they did before out of the lesser Glands. From the Glands to the common Receptacle they are called *Venæ lactææ secundi generis*, or of the second kind.

By the way we cannot omit to take notice of those three Glands which *Bartholin* calls *Lumbares*, from their being situated upon the *Loins*, and which he thus describes. * Two of them which are larger, lie one upon the other betwixt the descending *Cava* and *Aorta*, in that Angle which the Emulgents make with the *Cava*. The third being smaller stands over these, under the appendices

Bartholin
lumbares
lumbares

Glandulæ
lumbares
* *Anat.*
p. 108.
Edis. 74.

dices of the Diaphragm. They have communication, or are knit one to another by small lacteal branches, especially the two larger.] He once thought them to supply the place of the common Receptacle, in Man; that not being so plain in him as in several Brutes. But since a Receptacle is acknowledg'd as well in Men as Brutes, Dr. *Wharton's* opinion concerning their use seems more probable, *viz.* That they supply the place of those larger Glands that are found in the Mesenteries of Brutes, but are not natural to Men; And for this reason he presumes, that all such Animals as want those greater Glands in the Mesentery, have these *Lumbares* as well as Men. Several milky Veins are inserted into them, which rising out of them again, run to the common Receptacle.

Recepta-
culum
chyli.

This common Receptacle is called *Receptaculum Chyli Pecquetianum*, from *Pecquet* who first found out both it and the *ductus Thoracicus* (whose beginning it is) in the year 1651. It might as well be called *receptaculum Lymphae*, for that the *Lympha* passes not onely with the Chyle, but after this is all distributed, the *Lympha* still continues to glide into it and to ascend by the *ductus chyliferus Thoracicus*, which might be called *Lymphaticus* for the same reason.

Its site,
and sub-
stance.

It is seated under the Celiac Artery and Emulgent Veins, about the middle distance between the Kidneys and *capsulae atrabiliarie*, upon the *vertebrae* of the Loins, but for the most part rather toward the left side. It is of a membranous, but thicker substance in Men than in Brutes, but not so capacious, seldom being so large as to admit ones fingers end. Out of it there springs a duct that presently ascends through the Diaphragm at the

the same hole through which the *Arteria magna* descends, where (being now enter'd the *Thorax*) it begins to be called *ductus Thoracicus*. And now though it be past out of the *Abdomen* (of the contents whereof we are here treating) yet we will trace it through the middle Ventricle to the Heart whither it conveys its liquor, for the same reason that being above to speak of the Stomach, we thought it best to speak of the Gullet also, which is an appendage to it, and by which the meat descends into it.

This *Duct* then having past the Midriff, marches further upward under the great Artery till about the fifth or sixth *vertebra* of the *Thorax*, where it turns a little aside from under it to the left hand; and so underneath the intercostal Arteries and Veins, and the gland *Thymus*, it ascends to the left subclavian Vein, into whose lower side it opens, just there where the left Jugular Vein enters into it on the upper side, so that their Mouths face one another. But it opens not into this Vein with any large orifice, but by six or seven little ones, which are all cover'd in the interior Cavity of the *Subclavia* with one broad valve, looking towards the *Cava* from the Shoulder, whereby there is granted to the Chyle and *Lympha* a free passage out of the *ductus Chyliferus* into the *Subclavia*, but their return (or of Blood with them) out of the Vein into the Duct is prevented. This Duct ending thus in the subclavian Vein, the Chyle that it conveys into it passes with the Blood (returning by the *Cava*) into the right ventricle of the Heart, where we will leave it, and return to the *Venæ lactææ* again; having onely observed, that this Duct has many semilunar Valves that hinder the ascending Chyle and *Lympha*

*Ductus
chyliferus
thoraci-
cus.*

from gliding back again; which Valves are manifest by this, that the Chyle contained in the Duct may easily by the finger be pressed upwards, but by no means downwards; or if one make a hole in it, the liquor tending from beneath upwards will flow out at it, but that which is above it, is so stoppt by the Valves, that it cannot be made to descend by it.

The difference between the *Venæ lacteæ* and the ordinary mesaraical Veins.

The *Venæ lacteæ* differ from the ordinary mesaraick Veins,

First, in *bigness*; for the Mesaraicks are bigger, but the *Lacteæ* are far more in number. Which was necessary in that more Chyle must pass by them the way that has been spoken, to make Blood of, for the nourishment of the whole Body, than there can be Blood remaining from the nourishment of the Intestines onely, to return by the Mesaraicks to the Liver.

Secondly, they differ in *colour*, by reason of the great difference in colour of the liquors they contain. The Lacteals are white and limpid, by reason of the whiteness and clearness of the Chyle that is conveyed by them; but the Mesaraicks are of a dusky blackish colour.

Thirdly, they differ in their *insertion*; for the Lacteals, as has been said, are inserted into the great gland of the Mesentery, from whence they run forwards to the common receptacle; but the Mesaraicks all terminate in the Liver.

Their Valves.

They have a pretty many *Valves*, but not so many as the *ductus Thoracicus*. They may be discover'd the same way as we intimated those of the *Ductus* might, *viz.* that if they be pressed towards the great Gland, they are presently emptied; but if one press them from the Gland towards the

In-

Intestins, the Chyle will stop and cannot be driven thither.

By what has been said it sufficiently appears, *The reason of the motion of the Chyle.* what way the Chyle passes from the Guts to the Heart ; but there is another thing to be inquired in-*to, viz.* what should be the reason or cause of this motion. This we cannot impute to the *attraction* of the *Lactææ*, as if they sucked up the Chyle out of the Guts, for such elective attraction has been a long time exploded : but the true reason is, the pressure of the Guts, whereby the Chyle is squeezed through their spongy inner crust or coat into the mouths of the *Lactææ*. Which pressure proceeds *partly* from that undulating contraction of the Guts that is performed by their own fibres, which one may plainly observe in Coneys, &c. opened alive ; and *partly* from their being heaved to and again by the Muscles of the *Abdomen* in respiration. Now as soon as the Chyle is once got into the *Lactææ* we need not be solicitous for a reason of its further progress to the Receptacle and up the Thoracick duct ; for what is once got in, cannot slide back again, by reason of the Valves ; and seeing so long as there is any Chyle in the Guts, there is no cessation of its being prest into the *Lactææ*, that which comes behind must needs drive forward that which went before, by which it is made to ascend to the heart. Which ascent is also helped by the *lympba* that mixes with it in the receptacle and duct, not onely in that it is thereby diluted, but more especially from that motion which is impressed upon the *lympba* from the pulsation of the heart, whereby it is made to circulate by the Lympheducts, as well as the blood by the Veins.

C H A P. XI.

Of the Liver.

The Liver.
Its situation.

THE Liver is seated in the upper part of the Abdomen, namely about a fingers breadth distance from under the Midriff, in the right Hypochondre, (under the short Ribs) which, being of a great bulk, it quite fills in a manner, and reaches from thence towards the left side, a little beyond the *Cartilago ensiformis*, or pit of the Stomach. Its upper part is convex or round and smooth, the lower side is hollow, lying on the right side of the Stomach and *Pylorus*, &c. Its lower edge reaches below the short Ribs on the right side, and very near as low as the Navel before.

Lobes.

In Dogs and many other Brutes it is divided into divers Lobes, but in Man it is continuous; onely there is a little protuberance in its hollow side, to which the Caul is knit, which *Spigelius* called a Lobe, and from him others, but it is improperly called so, and not at all like the Lobes in the Livers of Brutes.

Ligaments.

It has three *Ligaments* (properly so called) which according to *Dr. Glisson* (*de Hepate*) are these. The first is called *Suspensorium*, because it suspends the Liver, or ties it up to the Diaphragm; it is broad, membranous and strong, arising from the *Peritonæum*, and is not onely fixed to the outer membrane of the Liver, but does indeed make it, and descends even into the Liver, and is strongly fastned to the common sheath or *involutum* of the *Vena cava* (there where the umbilical Vein is continuous to it.)

By

By this strong insertion it is the more able to bear up the great weight of the Liver.

The second is the *Vena umbilicalis*, which after the birth, closes up and hardens into a Ligament. It is directly opposite to the former. It passes out of the fissure of the Liver and terminates in the Navel. By this the Liver is kept from ascending upon the motion of the Diaphragm upwards in respiration.

The third is that whereby the Liver adheres to the *Cartilago ensiformis*. This is thin and flaccid, but yet strong, broad and doubled, arising from that Membrane wherewith the Liver is encompassed, (according to *Spigelius*) of which it is a duplicature (according to *Dr. Glisson*.) This hinders it from fluctuating to one or t^o other side, or towards the Back.

Besides these three Ligaments, it has several other connexions to the neighbouring parts, by the Vessels that come into it or goe out of it; but those would improperly be called Ligaments.

It is covered with a very thin *Membrane*, which Membrane springeth from the first Ligament, (as was said before) which cleaveth firmly to the substance of the Liver. If it be separated at any time by a watrish humour, issuing out of the capillary Lymphaticks, watrish Pustules, by the Grecians called *videtides*, are ingendred. If these break, the water falleth into the cavity of the Belly, and causeth that kind of Dropsie called *Ascites*.

Its *substance* or *Parenchyma* is red and soft, al- Substance most like concentered blood, and may, when it is boiled, be easily scrap'd or brusht off the vessels. But though its *Parenchyma* look red, that is onely from the great quantity of blood that is poured into it from the *Vena porta*: for its proper co-

lour is pale, a little yellowish, such as the Liver
 is of when 'tis boil'd (according to Dr. *Glisson*;) and yet that yellowishness seems to be caused
 by the Bile passing through it; so that *Malpighi*
us thinks white to be its proper colour, and gives
 a far different account of its *Parenchyma* from o-
 thers, whose observations by the Microscope are
 to this effect in his *lib. de Hepate, capp. 2, 3, 5.*
 " That 1. The substance of the Liver in Man is
 " framed of innumerable Lobules, which have
 " commonly each of them six sides like a Die,
 " and consist of several little Glands like the stones
 " of Raisins, so that they look like bunches of
 " Grapes, and are each cloathed with a proper
 " circumambient Membrane—2. That the whole
 " bulk of the Liver consists of these little grape-
 " stone-like Glands, and of divers sorts of Vessels;
 " and hence, that they may perform together a
 " common work, it is necessary that there be a
 " commerce betwixt these Glands and Vessels.
 " 3. That the little branches of the *Porta, Cava,*
 " and *Porus biliaris* do run through all even
 " the least Lobules in an equal number; that the
 " branches of the *Porta* doe the office of Arteries,
 " and that the *Porta* has so great society with
 " the *Porus biliaris*, that both their twigs are
 " straitly tied together in the same cover. 4.
 " That the shoots of the said Vessels are not joy-
 " ned by Anastomoses, but that the grape-stone-
 " like Glandules, making the chief substance of
 " the Liver, are a medium between the import-
 " ing, and exporting Vessels, so that by the inter-
 " position of these, the importers transfuse their
 " liquor into the exporters. From these obser-
 " vations he concludes the Liver to be a *congl-*
 " *merate Gland*, separating the Bile——And be-
 " cause

"cause it is usual for the conglomerate Glands to
 "have, besides Arteries, Veins and Nerves, a
 "proper excretory Vessel (as in the *Pancreas*, *Pa-*
rotides, &c.) dispersed through their substance,
 "receiving and carrying away the humour de-
 "signed for them, this kind of Vessel in the Liver
 "is the *Porus biliaris* with the Gall-bladder.]

And this is the opinion which is now received generally among Anatomists. And whereas several Lymphatick Vessels are said to arise from the Liver, and therefore it may seem to have a double excretory vessel, he thinks, that seeing in other places the Lympheducts use to arise not from conglomerate but conglobate Glands, therefore they do not truly spring from the Liver itself, but from those conspicuous conglobate Glands that are in the hollow of the Liver under the *involutum* or *capsula*, where the *Porta* and *porus biliaris* enter into it. Even as *Steno* observes, that the Lympheducts which seem to spring from the *Parotides*, do not indeed spring from them, but from a conglobate Gland that is contiguous to them.

It hath two sorts of *Veins*. In its upper part the *Vena cava* entrench into it, and spreads in self all through it in the lower as well as upper part. Into the lower side the *Vena porta* is inserted, whose branches likewise run through its whole *Parenchyma*. Of both these Veins more fully in the two following Chapters.

It has but very small and few *Arteries*, for the *Porta* serves it for an Artery, bringing blood to it. Those which it has, do all arise from the right branch of the *Arteria celiaca*, (called *hepatica*) there where it is joyned to the *Vena portae*, whence being sustained by the coat of the Gall

it ascends to the hollow of the Liver just by the said Vein, on whose coat, with the biliary Vessels, and the membrane of the Liver, it is wholly spent. For, as was said, the *Parenchyma* (so called) is nourished by the blood brought by the *Porta*.

Nerves.

It has *Nerves* from the Intercoastal pair, namely one from the stomachical branch thereof, another from the mesenterical (called *hepaticus*.) But the Nerves are extended onely to the Membrane and vessels of the Liver, (as the Arteries were) so that the *Parenchyma* has but a very dull sense.

Lympho-ducts.

Till the *ductus Thoracicus Chyliferus* was found out, it was still believed that the *Venae lacteae* were inserted into the Liver, which was looked upon as the great organ of sanguification; but now 'tis known for certain that no *Lacteae* at all go to the Liver, but that those vessels which were taken for such, are *Lymphatick* vessels carrying from it a most lymphid and pellucid juice. That they are dispersed in the *Parenchyma* of the Liver, has not yet been observed; nay, as was noted before, *Malpighius* believes they are not derived from the Liver at all, but from those conglobate Glands that lie under the *Porta* at its ingress into the Liver, and sometimes adhere to it, from whence taking their course chiefly along the Mesentery, they open themselves into the *receptaculum Chyli*. But supposing that they enter'd the substance of the Liver, lest any one should suspect them to be Lacteals, for which they were a good while taken after the Lacteals of the Mesentery were found out, but the common receptacle and thoracick duct were not as yet known; I say, lest any should suspect them to be Lacteals and

and so to import Chyle to the Liver, let him satisfy himself with this experiment, *viz.* let him make a ligature about any one of them or more, and he will see them presently swell betwixt the Ligature and the Liver, but be empty on that side towards the receptacle. And the same will be more evident if he examine their Valves also, which open towards the said Receptacle, but hinder any thing from coming back from thence to the Liver.

Concerning the *biliary* vessels we shall for-
bear to speak here, designing a particular Chapter
for them, *viz.* ch. 14. *The biliary
Vessels.*

Hippocrates in *lib. 4. de Morb.* says, *The fountain of blood is the Heart, the place of Cholera is in the Liver*; This comes very near the truth, as *Whether
the Liver
sanguifies.* shall appear hereafter. But from Galen downwards it was generally held that the Mesaraick Veins received the Chyle from the Guts and brought it to the Liver, where it was turned into Blood, and carried from thence into all the parts of the Body by the Veins. Yea and after the *Venæ lacteæ* were found out, they would needs have them to terminate in it, thinking it the fittest Bowel for sanguification, and presuming that that task must be performed by some or other. It would be needless here to stand to confute these opinions, now that all the world is convinced of their falsity, and by what hath been already said they may sufficiently appear to be erroneous, no Chyle at all coming to the Liver. How and where sanguification is performed, we shall shew when we come to the Heart, and here we shall declare the true office of the Liver.

The Liver then being discharged from sanguification, *The action
of the Liver.*

function, its office is assign'd to be for the separation of the Bile from the Blood brought plentifully to it by the *Vena porta*. As to the manner of its separation, some say it is merely by coagulation, others think a fermentation also necessary: but this is too intricate a controversy to enter upon here, and therefore waving it, I shall pass on to speak of the nature of the Bile.

The Ancients (amongst whom was *Aristotle*) thought it to be a mere excrement, and to be of no other use than by its acrimony to promote the excoriation of the Guts. And this opinion prevail'd so long as it was believ'd that the Liver had a nobler action than merely to separate the Choler. But now it being found out that it has no other office, it is believ'd that so bulky a Bowel was never made for the separation of a mere excrement, and therefore they think it to be a ferment for the Chyle and Blood, whereby if they were not attenuated and prepared, they could not be duly enspirited in the Heart. This new doctrine I shall give entirely out of *Diemerbroeck*, p. 134.

"The Blood flowing into the Liver by the *Porta*
 "out of the Gastrick and Mesaraick veins (and it
 "may be a little by the Hepatick artery) is mix-
 "ed with an acrimonious, saltish and subacid
 "juice, (made in the spleen of the arterious blood
 "flowing thither by the Arteries, and of the ani-
 "mal spirits by the Nerves) which is brought
 "into the *Porta* by the *ramus Splenicus*. Now
 "both these being enter'd the Liver by the
 "branches of the *Porta*, by means of this said
 "acrimonious and acid juice, and the specifick vir-
 "tue or coction of the Liver, the spirituous par-
 "ticles, both sulphureous and salt, lying hid in the
 "said venous blood, are dissolved, attenuated,
 "and

"and become also a little acrimonious and fer-
 "menting; a certain thinest part whereof, like
 "most clear water, being separated from the o-
 "ther thicker mass of the Blood by means of the
 "conglobated Glands, plac'd mostly in the hol-
 "low side of the Liver, is carried from thence by
 "many Lympheducts, as has been said. But
 "the fermentaceous spirits of greater acrimony,
 "mixed with the thicker and more viscid sul-
 "phureous juices (for Sulphur is viscid) and
 "more strongly boiling, whenas through the clam-
 "miness of the juices in which they inhere, they
 "cannot enter the conglobated Glands nor from
 "them the Lympheducts, and yet through their
 "fierce ebullition are separated from the Blood
 "(as Yest from Beer) these fermentaceous spirits
 "I say being sever'd with the juice in which they
 "inhere, become bitter and are called *Bile*.
 "Which Bile being transcolated through the
 "grape-stone-like Glandules into the roots of the
 "*porus Biliaris* and of the Gall-bladder, passes
 "through them by the *ductus Communis* into the
 "*Duodenum* or *Jejunum*, where it is presently mix-
 "ed with the pancreatick juice, and both of them
 "with the alimentary mass concocted in the Sto-
 "mach, and now passing down this way, which it
 "causes to ferment. And because at its first en-
 "trance it is more acrimonious, and has its virtue
 "entire, and so causes the greatest ebullition with
 "the pancreatick juice, hence the milky juice
 "contained in the mass concocted in the Stomach,
 "is most readily and in greatest quantity separa-
 "ted in the *Jejunum*, and by innumerable Lac-
 "teal vessels, (which are more numerous in this
 "than the other Guts) it is most quickly driven
 "on towards the *receptaculum Chyli*, and this is
 "the

"the reason that this Gut is always so empty.
 "But in the following Guts because the fermentaceous spirits are a little pall'd, the effervescency becomes slower and less efficacious, and the Chyle is more slowly separated from the thicker mass, and therefore they have fewer *Venæ lactæ*. At length what remains of this fermenting matter is mixed with the thick *faces* in the thick Guts, where by its acrimony it irritates them to excretion.] Thus far that perspicacious and judicious Anatomist. And indeed if the Liver have no other office but to separate the Choler, it is by no means to be reputed an excrement : for though the Liver do not sanguifie, yet however it is to be esteemed as a very noble part, seeing the diseases thereof are generally so dangerous, and wounds in it are so commonly mortal ; and by consequence that liquor which it separates must have some noble use, and such as is very necessary unto life.

C H A P. XII.

Of the *Vena portæ*.

Vena portæ.

THough it be the method of Anatomists usually to deliver the doctrine of all the Veins in a distinct Chapter or Book after the description of the three Ventricles ; yet seeing all the Veins seem (and by the Galenists have been affirmed) to have their root in the Liver, of which therefore we cannot but take notice ; on this account we will here describe their branchings with-
 in

in the *Abdomen*, seeing they are parts contained in it. Onely in contradiction of *Galen's* opinion we desire it may be noted, that their root is more properly said to be in those parts wherein they receive their blood from the Arteries, than in the Liver (or in the Heart) whither they convey it. Now we shall in the first place describe the branchings of the *Vena portæ*.

It is so called from the two eminences (called *Its name.* by *Hippocrates* πύλαι, *Portæ*, Gates) betwixt which it enters into the lower side of the Liver.

Some think that the *Vena umbilicalis* ought to *Origine.* be accounted its root or original, because it is first formed in the *Fœtus* and inserted into the *Porta*. But this umbilical Vein after the birth ceasing from the office of a Vein, and degenerating into a Ligament, though it might be accounted its root then, it cannot properly now. Others think, that because its branches every where inserted into the Intestins bring blood from thence to the Liver, (and not *vice versa*) therefore those ought rather to be accounted its roots, and its divisions within the Liver its branches. And indeed strictly and properly they ought to be accounted so, but however we shall not think it absurd to speak with the Ancients, who because they thought the *Porta* carried blood from the Liver to the Guts for their nourishment, suppos'd the Liver to be its root.

As it enters into the Liver, it is invested with another Coat, which some call *Vagina portæ*, its Sheath, others *Capsula* or *involutum* its Case, or cover, and *Capsula communis* because the *Porus biliaris* is involved in it as well as the *Porta*. This outer Coat it has immediately from the membrane that cloaths the Liver, that is, it is continued from

from it, though it be of a clear other substance, namely more dense and carnous. It is invested with it in all its ramifications, and so having a double Coat is in that respect an Artery, as also in that it brings blood to the Liver for its nourishment as well as for other uses, and lastly in that by means of the *Arteria hepatica* inserted into the *Capsula* it has an obscure pulsation (according to Doctor Glisson.)

Branch-
ings in the
Liver.

When it is enter'd about half an inch into the Liver, it is carried partly to the right hand, partly to the left, and so is shap'd into a *Sinus* as it were, and thence is divided into five large branches, four whereof are diffus'd all over the hollow side of the Liver, but the fifth ascends streight to its upper side where it disperses it self. And the said *Sinus* is more conspicuous in an *Embryo*, because the great influx of nutritious juice out of the Umbilical vein enlarges it much. Moreover in an *Embryo* you may easily see the *Tubulus* or *Canalis venosus* passing directly out of this *Sinus* into the *Cava* (almost opposite to the mouth of the Umbilical vein.) This *Canalis* or Pipe is of the same substance and texture with a Vein, and enters into the *Cava* just where it is knit to the Diaphragm; and there also two other great branches out of the Liver are inserted into the *Cava*; and in the same place this Pipe is also knit to the suspensory Ligament spoken of before, and after the Child is born grows it self into a Ligament, being in a manner opposite to the umbilical Ligament. But to return to the divisions of the *Porta*. The Ancients taught that they were onely spread in the sinous or hollow part of the Liver, but Dr. Glisson in his accurate Anatomy of it, affirms the *Porta* to be dispersed very equally in all its parts, upper

upper as well as lower. And whereas it has been a constant doctrine, that the branches of the *Porta* open by anastomoses into those of the *Cava*, the same learned Author, and many others since him, have observed that there are no such anastomoses at all, but that the blood doth ouze through the glandulous *Parenchyma* of the Liver out of the Capillary veins of the *Porta* into those of the *Cava*. He that would be fullier informed hereof, may consult his most accurate Book *de Hepate*. But we will now pass to the branches of the *Porta* when it is gone out of the Liver.

This Trunk having past a little from the Liver, before it be severed into branches, puts forth two twigs, out of its upper and fore-part, which are inserted into the *Cystis fellea* or Gall-bladder (and are from thence called *Cystica gemelle*) about the neck of it, and spread by innumerable twigs through its external coat.

Its branches without the Liver.

A third twig also arises single from it, which is larger than either of the former, and is inserted into the bottom of the right side of the Stomach, from whence it ascends by its hinder side up to the *Pylorus*, which gives it the name of *Pylorica*; it is otherwise called *Gastrica dextra*.

Having sent forth these three twigs, the Trunk passeth down, and bending a little towards the left side, it is parted into two remarkable branches; whereof the upper is called *sinister*, or the *left*, and is the lesser: the lower *dexter*, or the *right*, which is the larger. The *left* is bestowed upon the Stomach, the *Omentum*, a part of *Colon*, and the Spleen; the *right* is spread through the Guts and Mesentery: the *left* is called *Vena splenica*; but the *right Vena mesenterica*.

The

Vena splenica.

The *Vena splenica* runs across the body towards the left side, being sustained by the hinder leaf of the Caul, and hath two branches issuing out of it before it come to the Spleen, viz. the *superiour* and the *inferiour*.

The *superiour* is called *Gastrica*, or *Ventricularis*, because it is bestowed upon the Stomach. It ascends obliquely towards the left part of the Stomach, into the back side whereof it is inserted, and divides it self into three sprigs, of which the two outmost are spent on the body of the Stomach, but the middle ascends on its back side up to its upper or left orifice, which it encompasses like a garland, and is called *Coronaria*. From the *inferiour* branch two twigs spring; The one is small, and sends twigs to the right side of the inner leaf of the *Omentum*, and to the *Colon* annexed to it. This is called *Epiplöis* or *Omentalis dextra*. The other is spent upon the same leaf of the *Omentum*, with that part of the *Colon*, which it ties to the Back, and is called *Epiplöis* or *Omentalis postica*.

When the *Ramus splenicus* hath just approached to the Spleen, it sends out two other twigs, the upper and lower. The upper is called *vas breve venosum*, and is implanted into the left part of the bottome of the Stomach. It is sometimes single, in which case it is properly called *vas breve* in the singular number; but more often there are two, three or more of them, and then they should be called *vasa brevia*. And note that these vessels, be they one or more, do sometimes spring from the *Ramus splenicus* after it has entred the Spleen.

This *vas breve* was a vessel much renowned by the Ancients, who believed it carried an acid juice from the Spleen to the Stomach to stir up
appe

appetite and to help the fermentation of the meat in it; but it is certain both by Ligature (whereby it filleth toward the Stomach and emptieth toward the Spleen) and also by the general nature of Veins, whose smaller branches and twigs still receive the superfluous Arterial blood from the part whereinto they are inserted, and conduct it by the larger chanel towards the Heart; I say it is certain from hence, that this same *vas breve* carries nothing to the Stomach, but onely brings from thence into the *Ramus splenicus* the remains of the arterial blood.

From the *lower*, two Twigs issue.

The first is called *Gastroepiplois sinistra*; this is bestowed upon the left part of the bottom of the Stomach, and the fore leaf of the *Omentum*, chiefly on its left part.

The second springeth most commonly from *Ramus splenicus*, but sometimes from the left Mesenterick vein; and running along the *Intestinum Rectum*, is inserted into the *Anus*, by many twigs. This is called *Hæmorrhoidalis interna*, as that which springeth from the *Vena cava* is called *Hæmorrhoidalis externa*.

Now followeth *Vena mesenterica*, or the right Vena mesenterica. Before it be divided into senterica. branches, it sendeth forth two twigs.

The first is called *Gastroepiplois dextra*; this is bestowed upon the right part of the bottom of the Stomach, and the right side of the upper leaf of the *Caul*.

The second is called *Intestinalis*, or *Duodena*: It is inserted into the middle of the *Duodenum*, and the beginning of the *Fæjunum*, and runneth lengthways of them: whence some capillary twigs go to the *Pancreas* and the upper part of the *Omentum*.

G After

After these twigs are past from it, it enters by one trunk into the Mesentery, where presently it is divided into two branches, to wit, *Mesenterica dextra, & sinistra*.

Mesenterica dextra (placed on the right side) is double, and sendeth a great number of branches to the *Jejunum*, *Ileum*, *Cacum*, and the right part of the *Colon* which ascendeth up by the right Kidney and runs under the Liver.

It hath fourteen remarkable, though nameless branches; and these are afterwards divided into innumerable small twigs. These are those Veins that are called the Mesaraicks, whose branches are supported by the Glandules of the Mesentery, but enter not into them; for the Glands minister to the *Venæ lacteæ*.

Mesenterica sinistra passeth through the middle of the Mesentery, to that part of the *Colon* which descendeth from the left part of the Stomach, and to the *Intestinum Rectum*.

The use of the Porta. The use of the *Porta*, before the circulation of the blood, and the *Venæ lacteæ* were found out, was taught to be for the carrying of nourishment to the Intestins and other parts contained in the *Abdomen*, and also to bring back from the Guts the purer part of the Chyle to the Liver to make Blood of, and a thicker feculent part of it to the Spleen, to be excocted by it into an acid juice, and then carried to the Stomach by the *vas breve venosum* for the exciting of hunger. As for this last opinion, it appears by Ligature that the *vas breve* carries its contents from the Stomach to the *Ramus splenicus*, and it is nothing but the Blood remaining from the nutrition of the Stomach (that was brought thither by the Arteries) which is now a conveying back to the Liver and so to the

the Heart again in its circulation. And as for the Mesaraicks carrying nourishment to the Guts, or bringing back Chyle, those errors have been sufficiently laid open before in the Chapters of the *Vena lactea* and the Liver. And their true use is onely to bring back to the Liver from the Guts that Bloud which remains after their nutrition, and which was carried to them by the mesaraick Arteries.

CHAP. XIII.

Of the Vena Cava dispersed within the Abdomen.

THE *Vena cava* is so called from its large Cavity, being the most capacious of any Vein of the whole Body; for into it as into a River or common Chanel do all the other Veins like Rivulets (excepting the *Pulmonaria*) empty themselves. Both within and without the Liver it hath but a single Coat.

Its root may very properly be said to be in the Liver; for by its Capillaries it receives the Bloud that is transcolated through the glandulous *Parenchyma* of the Liver from the Capillaries of the *Porta*, and by its ascending trunk conveys it to the Heart. Now these roots may in some regard be commodiously enough also called branches; for the roots of a Tree in the Earth, as well as its boughs in the Air are spread into many branches: onely there is this difference, that roots bring juice to the trunk, but boughs carry it from

Vena cava.
Its name.

Rise.

the same. However we shall call them indifferently roots or branches. The capillary branches then of the *Cava*, are spread through the whole substance of the Liver, and not its upper or gibbous part onely, as has formerly been taught; even as we said before that the Capillaries of the *Porta* were indifferently dispers'd all over it. Betwixt these Capillaries (much less betwixt their larger branches) there are no inosculations or anastomoses, but those of the *Porta* being quite obliterated in the glands or glandulous *Parenchyma* of the Liver, these of the *Cava* arise out of the same, and whiles they pass towards the trunk of the *Cava* many of them meeting together make a twig, as many twigs in like manner concurring make a branch, which still proceeding further, by the accession of new twigs and branches becomes larger and larger, and at length dischargeth it self into the *Cava*. And thus do all the roots of the *Cava* in the Liver. But they do not all meet together in one common trunk within the Liver, as those of the *Porta* do, but empty themselves apart into the *Cava* without the Liver. And still the further distance the Capillaries have their origine from the *Cava*, the larger their channel comes to be at their arrival at it. The smaller twigs are innumerable; the larger roots joyning immediately to the *Cava* are commonly but three, though two of them are presently (towards the Liver) divided into other two, as large each as themselves, so that one may account them to be five. These emptying all the Bloud exhausted out of the Liver into the *Cava*, it is presently divided into the Ascending and Descending trunk. The *Ascending* forthwith enters the Diaphragm and marches up the *Thorax*, where

where we shall leave it till we come thither, and onely here speak of the *Descending* trunk as long as it continues in the *Abdomen*.

The *Descending* trunk is somewhat narrower than the *Ascending*, and passing down along with the great Artery it continues undivided till the fourth *vertebra* of the Loins. But in the mean time it sends forth divers branches from its trunk. *Its descending trunk.*

1. The *Vena adiposa*, for the Coat and fat of the Kidneys; whereof that on the left side goes out first.

2. The *Emulgents*, which run to the Kidneys by a short and oblique passage; these bring back that blood to the *Cava* which the emulgent Arteries carried to the Kidneys with the *Serum*.

3. The *Spermaticks*, called *Vasa præparantia*. The right springeth from the trunk of *Vena Cava* a little below the Emulgent; but the left from the left Emulgent it self. Of these more in the 20th Chapter.

4. The *Lumbares*, sometimes two, sometimes three. These run in between four *vertebrae* of the Loins, and are dispersed through the membranes that cloath the spinal marrow.

All these Veins being sent forth of the trunk, by this time it is come to the fourth *vertebra* of the Loins, where it turns to behind the *Arteria magna*, above or before which it had thus far descended, and is divided into two equal branches, called *Iliaci*; because they pass over the *Os ileon*, &c. as they go down to the Thighs.

Just about the division there spring two Veins called, *Muscula superior*, for the *Peritonæum* and Muscles of the Loins and *Abdomen*; and *Sacra*, which is sometimes single, sometimes double, for

the marrow of *Os sacrum*, or rather for the membranes that cloath it.

Afterwards the Iliacal branches are again divided each into two other, the Exteriour that is greater, and the Interiour that is less.

From the *interiour* arise two Veins : *Muscula media*, for the Muscles of the Hip and Buttocks ; and *Hypogastrica*, which is a notable one, sometimes double, ministring to most parts of the *Hypogastrium* ; as, to the Muscles of the streight Gut, (which branches make the external Hemorrhoidals ;) to the Bladder and its neck, to the Yard, and the lower side of the Womb and its neck, which last are the Veins by which the Menstrues were believed to pass, before the circulation of the Blood was found out ; for since, 'tis known that they pass by the Hypogastrick Arteries, and what Blood is not sent forth at those times, or at other times is not spent on the nutrition of these parts, returns by these Veins to the *Cava*, and by it to the Heart.

From the *exteriour*, three : two before it goes out of the *Peritonæum*, and one after.

1. *Epigastrica*, for the *Peritonæum* and the Muscles of the *Abdomen* ; the most noted branch of it ascends under the *Musculi recti* towards the *Vena mammaria*, with which they have been thought to inosculate about the Navel.

2. *Pudenda*, for the Genitals in Men and Women.

3. *Muscula inferior*, for the Buttocks.

And now the descending branches of the *Cava* are past out of the *Abdomen* into the Thighs, and begin to be called Crural ; and of them we shall discourse when we come to the *Limbs*, in Book 4. cap. 4.

Now

Now the use of this Descending trunk of the *Its use.*
Vena Cava is not to carry any thing to any part from the Liver; but wheresoever its lesser twigs end into Capillaries, from thence is Bloud received (being brought thither by the respective Arteries) and conveyed into the greater branches, and by them into the trunk of the *Cava* by which it ascends to the right ventricle of the Heart, there to be anew inspirited, and from thence to be sent forth again by the Arteries, as shall be further explained when we come to the Heart.

For though the Descending trunk of the *Aorta* or great Artery pass down the *Abdomen* along with that of the *Cava*, and so is contained therein as well as it; yet because the Arteries have all of them their origine from the Heart, we will forbear to speak of *them* till we come to the Anatomy of *it*, in the next Book.

C H A P. XIV.

Of the Gall-bladder and Porus bilarius.

FOR the receiving and evacuating of Bile there are two Vessels or passages framed in the right and hollow side of the Liver, namely the Gall-bladder, and Porus bilarius. By this latter there flows a thicker but milder, by the former a thinner, more acrimonious and fermentative Choler into the Intestins.

The Gall-bladder, called in Greek *χοληδόχος*,
 in Latine *Vesica biliaria*, or *Folliculus fellis*, is a
 hollow

The Gall-
 bladder.
 Its name
 and de-
 scription.

Hollow Bag placed in the hollow side of the Liver, and in figure representeth a Pear.

Bigness. It is about two inches in length, and one in breadth.

Connexion. By its upper part it is tied to the Liver, which doth afford it a hollownes to lodge in; but the lower part which hangeth without the Liver, resteth upon the right side of the Stomach, and the Colon, and doth often dye them both yellow.

Membranes. It hath two *Membranes*, the one *common*, which is thin and exteriour, without *Fibres*. This springing from the Membrane of the Liver, onely covereth that part which hangeth without the Liver. The other Membrane is *proper*.

The fibres of the proper membrane. This is thick and strong, and hath three sorts of *Fibres*; the outermost are transverse, the middlemost oblique, and the innermost streight.

Within, it hath a mucous substance or crust, engendred of the Excrements of the third concoction of its Membrane, to withstand the acrimony of the Choler. Though some there are that reckon this crust for a third membrane, and affirm it to be full of glands.

Parts. It hath two *parts*, the *Neck* and the *Bottom*.

The *Bottom* is its larger or wider part that contains the choler, and is of the same colour with the bile that is in it; whence it commonly looks yellow, but sometimes greenish, blackish, &c.

The *Neck* (otherwise called *meatus cysticus*) is its narrower part, and is wrinkled on its inside, to moderate the too hasty descent of the bile; and joining it self to the *Porus bilarius*, they both make the *Ductus communis*, or common passage of the Choler, which is inserted into the beginning of the *Jejunum*, or the end of the *Duodenum*.

The Ancients (whose opinion is of late stiffly defended by Dr. * Cole) thought that the Choler in the Gall-bladder was received in by its neck from the *Porus bilarius*, and that it passed out into the common duct the same way. And to obviate the objection, that there uses not to be a reciprocation of humours in the same Vessel, (at the same time especially) Dr. Cole supposes that the Gall passes out of the Gall-bladder onely in the time of the distribution of the Chyle, but at all other times it is received into it from the *porus*, and is stored up in it against the next occasion. But not to enter into this dispute, I think Dr. Glisson's account of it the more probable, viz. That the Choler is conveyed into the *Vesica* by many very small roots, dispersed in the hollow part of the Liver, among the branches of the *Porta* and *Cava*: they are so very small that they are scarcely discernible; but when they meet together, they make one pretty notable Trunk, which is inserted into the *Cystis* near its Neck, with a Valve before its Mouth to hinder the regurgitation of the Choler. (For in the Jaundice the Choler does not return out of the Gall-bladder into the Bloud again, but either for want of a convenient ferment it is not separated from the Bloud, or when the neck of the *Vesica* is stop't that none can pass out of it into the Guts, then the Gall-bladder is presently so fill'd that it cannot receive any more; and so the Choler being forc'd to stagnate in its roots, is received in by the branches of the *Cava*, and thereby contaminates the whole mass of Bloud.) But though it be evident that the Choler is brought into the *Vesica* by this Pipe, yet if one open the Bladder to look for its Mouth in the Cavity, one shall hardly find where

How the
choler is
brought
into it.

* De se-
cret. Ani-
mal. c. 14.

where it is ; which is no wonder , seeing it is so difficult to find the insertions of the Ureters into the urinary Bladder, which are vastly larger than this. But near its neck in the inside, there is a little spongy protuberance, into which this Trunk is pretty plainly inserted ; and this protuberance is the same that we called before a Valve.

Of its circulation.

Jo. Alph. Borellus (Professor of the Mathematics at Naples) from the continual and speedy efflux of the Bile by the *Ductus communis* into the *Duodenum*, believes that there is a particular circulation of it. For he affirms, that in a days time, from a person fasting, there pass thirty four pound of bilious juice into the *Duodenum* by the common duct, whereas the whole mass of Gall amounts not to above two pound ; from whence as he concludes, that so great a quantity of Gall cannot be produced in the Liver by way of fermentation, but that it is separated mechanically, without the help of any ferment, onely by *Cribration* from the minute vessels of the *Porta* through the pores of the glands of the Liver, as the urine is separated in the Kidneys ; so he infers that there is a particular circulation of the *bilis* through the abdomen, perform'd by the *Venæ mesaraicæ* into the trunk of the *Porta*, thence to the Liver, thence through the bilious vessels into the *Duodenum*, to return again by the *Mesaraick Veins*. He that would inquire more into this novel and (to me) improbable opinion, may consult his *opus posthumum* (pars altera) *de motu Animalium*.

The valves of the Gall-bladder.

It has been taught by several Anatomists, that its Neck or *Meatus* has sometimes two, sometimes three Valves to hinder the recourse of the Choler : but *Diemerbroeck* professes he could never find any, but onely that the egress of the *Vesica* was

was very strait, and its Neck wrinkled. Dr. Glisson declares also that he could never discover any in it, but on the contrary, he has often with a slight compression of his fingers found, that the Choler will fluctuate to and again, out of the *Cystis* into the *Meatus*, and on the contrary, as also out of the *Meatus* into the *Ductus communis* and back again; so that he cannot believe there is any thing of a Valve in the whole passage. But one thing which he thinks has impos'd upon Anatomists, is a certain fibrous Ring (or *Sphincter* as it were) which is seated just at the end of the Bladder and beginning of its Neck, which makes the passage betwixt them exceeding strait; but this cannot be a Valve, because as he observes the Choler will go either way through it.

The *Vesica fellea* hath two *Veins* called *Cysticae* *Its vessels.* *gemellae*, which spring from the *Porta*. It hath twigs of *Arteries* proceeding from the right branch of the *Cœliaca*. And it hath a small thread-like sprig of a *Nerve* from the Mesenterical branch of the Intercoastal.

Many times *Stones* are found in it, which are *Of the* lighter and more spongy than those of the urinary Bladder, and will swim above water. *stones in it.*

The other passage which carrieth the thicker *Porus* bilar sort of Choler, is called *Porus biliaris*, or *Meatus larius.* *bepaticus*, because it passeth directly from the Liver to the *Ductus communis*.

Within the Liver its Trunk and Branches are *Its Coats,* invested with a double coat; its proper one, *and branchings* which it retains without the Liver also, and another that is common to it with the *Porta* called *the Liver.* *Capfula communis*, which it has from the membrane of the Liver. In this common coat this *Porus*

Porus and the *Porta* are so closely enwrapped, that you would take them but for one Vessel, till you either hold it up to the light, (which will discover Vessels of two colours in it) or very dextrously rip up the *Capsula*, and so lay them open. Its roots within the Liver are equally divided with those of the *Porta* every where, saving that little space where the roots of the *Vesica* are spread, in the sinous and right side of the Liver. So that having spoken above of the divisions of the roots of the *Porta*, I shall refer the Reader thither for these of the *Porus*. I shall onely observe, that they are far larger and more numerous than those of the *Vesica*, drawing Choler from all the parts of the Liver (saving whither the roots of the Bladder reach) and that more thick and viscous, yet less acrimonious.

All Animals have it.

This *Porus* seems to be a more necessary part than the *Vesica*; for many Creatures, as Harts, Fallow-deer, the Sea-calf, &c. and those which have a whole Hoof, as an Horse, &c. have no Gall-bladder, but there is none that is destitute of this.

Its connexion with the meatus.

Without the Liver it is as wide again as the *Meatus cysticus*, with which it is joyned at two inches distance from the Liver, and both make the *Ductus communis choledochus*.

It hath no Valve,

It has no *Valve* in its whole progress; onely the *Ductus communis*, where it enters the Intestin, having pierced the outer coat, passes betwixt that and the middlemost about the twelfth part of an inch, and then piercing that also marches down further betwixt it and the innermost coat about half an inch, and at last opens with a round mouth into the Intestin. So that this oblique insertion (as that of the Ureter into the urinary Bladder)

Bladder) serves instead of a Valve to hinder any thing from regurgitating out of the Gut into this Duct, especially the inmost Tunicle of the Intestine hanging so flabby before its mouth, that when any thing would enter in, it claps close upon it and stops it.

As to any *anastomoses* of the roots of either of these Biliary vessels with those of the *Vena Porta*, such indeed have been much talkt of, but without truth, for their extreme Twigs or Capillaries terminate in the *Parenchyma* of the Liver, out of whose Grape-stone-like Glandules they imbibe the Choler there separated from the Blood; even as was said before of the Capillaries of the *Cava*, that they received the Blood it self imported by the *Porta*, in like manner, without any inosculation.

The use of both these Vessels may sufficiently be learned by what has already been said of them. Though some are of opinion, that not onely choler, but other superfluous humours are evacuated by them, especially upon taking a Purge.

The use of the *Bile* it self appears from what we quoted above out of *Diemerbroeck*, when we were treating of the action of the Liver, cap. 12. We will onely further note two things.

First, that sometimes the *Ductus communis* is very irregularly inserted. For in some it is knit to the bottom of the Stomach, and then the party vomiteth Choler, and is termed *πυλόχολος ἀνα*; and sometimes it is inserted into the lower end of the *Jejunum*, and then bilious dejections follow; and such a one is termed *πυλόχολος κατω*.

A second thing is concerning the colour of the Bile; that though for the most part, in a healthfull state) it be yellow, yet preternaturally and

nor Anastomoses with the Porta.

The use of the Vesica and porus.

Observ. 1.

Observ. 2.

in

in a morbus state it is often of several other colours, as pale-coloured, eruginous, porraceous, vitelline, reddish and blackish. And when it thus degenerates and corrupts, it is the cause of most violent and acute Diseases; as the *Cholera morbus*, Dysentery, Colick, &c.

CHAP. XV.

Of the Pancreas.

The Pan-
creas.
Its sub-
stance.

THE *Pancreas* (as much as to say *All-flesh*) or the *Sweet-bread*, except its Membranes and Vessels, is wholly Glandulous. It seems to be compacted out of many globules or knots included in a common Membrane, and joyn'd one to another partly by Membranes, and partly by Vessels. Every Globule by it-self is somewhat hard; but all together (because of their loose connexion) seem softish. It is of a palish colour, very little tintured with red. Its investing Membrane it has from the *Peritoneum*.

Situation. It is seated under the bottom and towards the hinder side of the Stomach, and reaches from the Caviry of the Liver (namely from that part where the *Porta* enters it) to the lower end of the Spleen, cross the *Abdomen*. It is knit also to the *Duodenum*, (sometimes to the) *Porus biliaris*, the *Rami splenici*, the *Caul*, the upper part of the *Mesentery*, and upper *Nervous plexus* of the *Abdomen*. It is not joyned to the Spleen.

Figure. Its figure is long and flat, broader and thicker about

about the *Duodenum*, but towards the Spleen thinner and straiter.

It is lesser than most of the *Viscera*, commonly *Bigness*. about five fingers breadth long; where it is broadest, it is about two fingers breadth, and about one fingers breadth thick.

Its *Vessels* are of five kinds. *Veins* it has from *Vessels*. the splenick branch; *Arteries* from the left branch of the *Cœliaca*, sometimes from the splenick; *Nerves* from the Intercoastal pair, especially from the upper plexus of the *Abdomen*; it has also many *Vasa lymphatica*, which, as the rest, pass to the *Receptaculum chyli*.

But besides these *Vessels* which are common to *Ductus* it with other parts, it has a proper membranous *pancreaticus*. Duct of its own, which was first found out by *Wirsungus* at *Padua* about forty years agoe. This *Vessel* commonly has but one Trunk, whose orifice opens into the lower end of the *Duodenum* or beginning of the *Jejunum*, and sometimes is joined to the *Ductus biliaris* with which it makes but one mouth into the Intestin. Within the *Pancreas* (according to *Dr. Wharton*) it is divided into two Branches, which send forth abundance of little Twigs into all the *Globuli* above spoken of, where they imbibe the humour that is separated by them from the *Arteries*, and by their Trunk transmit it to the Guts. This *pancreatic* humour tho' is never found in this Duct, because it flows so quickly out of it into the *Duodenum* by a steep way; even just as the Urine, passing out of the Reins by the Ureters to the Bladder, is never found in them because of its rapid transit.

Very many have been the differences of *Office*. opinions concerning the office of this Glandule. Some have thought it to be onely of use to sustain the divi-

divisions of the Vessels, and to serve the Stomach for a Cushion to rest upon; others, that it ministers a ferment to the Stomach; others, that it receives the Chyle, and brings it to greater perfection: and others, that it serves as a Gall-bladder to the Spleen, or sometimes serves in its stead. Which opinions being all very unlikely, I shall not spend time to examine them.

The nature of the pancreatic juice.

There are three other opinions, for the *first* whereof let the credit of the learned Author (*viz.* Dr. Wharton) recommend it as it can, but to me it seems improbable, and it is this, That it receives the excrements or superfluities of the superiour *plexus* of the Nerves of the sixth pair (Dr. Willis's Intercoastal or ninth pair) being united with some branches from the spinal marrow, and by its proper Vessel or Duct discharges them into the Intestins. In answer unto which I shall onely say this, That I cannot tell how thick Excrements should be convey'd by the Nerves that carry such pure animal spirits, and have no visible Cavity; nor secondly how these Nerves in particular should *cum delectu* (as he speaks) send the Excrements hither, and all the rest be discharged from any such Office.

The *second* opinion is somewhat more probable, and is defended by famous Physicians and Anatomists, as *Franc. Sylvius, Bern. Swalve, Regn. de Graef* and *Isbrand de Diemberbroeck*, from which last I shall transcribe it. "I have found, *saieth he*, in the "dissections of Brutes both alive, and newly "strangled, a certain liquor sublimpid and as it "were salivous, (something austere and lightly "subacid, and having sometimes something of "saltishness mixed) to flow out of the *Ductus* "pancreaticus into the *Duodenum*, sometimes in a pretty

“ pretty quantity. Whence I judged—that
“ there is excocted in the *Pancreas* a peculiar hu-
“ mour from the serous and saltish part of the ar-
“ terial blood brought into it, having some few
“ animal spirits convey’d thither by small Nerves
“ mixed with it, and that this liquor flowing into
“ the *Duodenum*, and there presently mixed with
“ the Bile, and the meat concocted in the Sto-
“ mach gliding by the *Pylorus* into the Guts, does
“ cause a peculiar effervescency in those aliments,
“ whereby the profitable chylous particles are
“ separated from the unprofitable, are attenua-
“ ted, and being brought to greater fusion (This
“ operation of it, *says he*, is shewn by the diver-
“ sity of the substance of the aliments, concocted
“ in the Stomach and still there contained, from
“ that of those which have already flow’d into
“ the Intestins: for the former are viscid and
“ thick, and have the various colours of the food
“ taken; but the latter on the contrary are more
“ fluid, less viscid, and more white) are withall
“ made apt to be impelled by the peristaltick
“ motion of the Guts, through their inner mu-
“ cous coat into the Lacteal Vessels, the other
“ thicker, by little and little passing down to the
“ thick Guts, to be there kept till the time of
“ excretion. Now this effervescency is caused
“ through the volatile salt and sulphureous oil
“ of the bile meeting with the acidity of the
“ pancreatick juice; as in Chymistry we observe
“ the like effervescencies to be caused by the con-
“ course of such things.] Thus he. So that he
“ will not have this juice to be any thing excremen-
“ tious, nor to be so very little in quantity as some
“ have affirmed; to demonstrate which he cites
“ the experiment of *de Graef*, who in live-dissections
“ H could

could gather sometimes an ounce of it in seven or eight hours time, which he has tasted, and found it of the tast before-mentioned, *viz.* something austere, subacid and saltish. *Vide ejus Anatonem corporis humani*, p. 73, &c. where you may see what Diseases it is the cause of when distempered.

A third opinion is that of *Brunnerus*, who thinks that the *Pancreas* is of the same use with the other conglomerate glands of the Mouth, Throat, Stomach and Guts, and its juice of the same nature with the *saliva*. That it consists of *lymph*a separated from the Arteries, and of Animal or nitro-aereal spirits communicated by the Nerves. That like the *saliva* it is a Dissolvent or *Menstruum* in concoction and chylification, but does not ferment with the bile, but onely takes somewhat off its acrimony. That its juice is not of any *peculiar* sort he endeavours to evince by repeated experiments upon Dogs, from some of whom he cut the greatest part of the *Pancreas*, and in others cut asunder its Duct that passes from it to the Intestins, and yet they continued (after two or three day, indisposition) to be as lively, and in every respect in the same condition as before. From whence he concludes, that that juice which naturally flows out of the *Pancreas*, must in these cases be supplied from other parts; and therefore that it is of no *peculiar* nature, but of the same with that of those parts that supply its defect, and those can be no other than the conglomerate glands of the parts aforesaid. He that would be further satisfied in the grounds of this opinion, or how this ingenious Author made his experiments, may consult his Book lately published, entitled *Experimenta nova circa Pancreas*, &c.

C H A P. XVI.

Of the Spleen.

THE Spleen is so called in English from the *The Spleen.*
Greek σπλήν, from whence also the Latin *Its name.*
word *Splen* is derived. It is otherwise called in
Latin, *Lien*; and in English the *Milt*.

It is commonly but one in Men, though some *Number.*
have found two, yea *Fallopins* three. In Dogs
there are sometimes two or three, unequal in big-
ness, out of each of which there passes a vessel in-
to the *Ramus Splenicus*.

In Infants new born it is of a red *Colour*; in
those of a ripe age it is somewhat blackish; and in *Colour.*
old Men it is of a leaden or livid colour.

In Man it is broader, thicker and heavier than *Bigness.*
in Beasts; for it is about six inches in length, three
in breadth, and one in thickness. Sometimes it
is much larger, but the bigger the worse. *Spigelius*
has observed that it is larger in those that live in
fenny places, than in those that live in dry; and
in those that have large Veins, than in them that
have small.

As to its *figure*, *Hippocrates* compares it to an Oxe's *Figure.*
Tongue; *Aristotle* to an Hog's milt. Towards the
Stomach on its inner side it is somewhat hollow;
on its outer, gibbous, having sometimes some im-
pression upon it from the Ribs. It is smooth and
equal on either side, save where in its hollow
side it has a streight line or seam (*ῥαφή*) at
which place the splenick Vessels enter into it. Its
upper end is called its *head*, and the lower its
tail.

Situation. It is seated in the left *Hypochondrium* opposite to the Liver : (so *Hippócrat.* 6. *Epidem.* calleth it the left Liver ; and *Aristot.* 3. *de histor. animal.* 7. the bastard Liver) betwixt the Stomach and that end of the Ribs next the Back ; in some higher, in others lower : but naturally it descends not below the lowest Rib. Yet sometimes its Ligaments are so relaxed, that it reaches down lower, yea sometimes quite break, so that it slips down into the *Hypogastrium* : so *Riolanus* tells the story of a Woman that was troubled with a Tumour there, which was taken by her Physicians for a Mole, but dying of it, and being opened, it was found to be occasioned by the Spleen fallen out of its place and lying upon the Womb.

*Whether
it may be
cut out of
the body
with safety.*

And as it very much endangers life when it falls out of its place, so can it not without great danger be quite cut out of the Body, whatever some have boasted of. For how can one imagine that a part so difficult to come at, and that has such large vessels inserted into it, (not to mention its use) can with safety be taken out of the Body ? Wounds in it are commonly mortal ; inflammation, or but obstructions in it do grievously afflict the Patient and sometimes kill him : sure then the total ablation of it must be very fatal. And yet (among others) the ingenious *Brunnerus* in the preface to his above-cited book affirms, that he first took the Spleen from a Dog, and at some distance of time by a second operation cut out the greatest part of the *Pancreas* from the same, and yet he continued to eat and drink, shit and piss, and run about as briskly as if he had wanted neither of them, till about three months after the last operation he was lost in a crowd. But of this more by and by when we come to the use of the Spleen.

It

It is tied to five parts; its upper part to the Midriff (commonly) and its lower to the left Kidney by thin Membranes; by its hollow part which giveth way to the Stomach being distended, to the upper membrane of the *Omentum*, and to the Stomach by sundry vessels. Its gibbous or arched part is knit to the *Peritonæum* by thin membranes.

Connexion.

The *substance* of it is flabby, loose and spongy, commonly held to be a concrete sanguineous body, serving to sustain the vessels that pass through it: but *Malpighius* with his Microscope has discover'd it to be a *Congeries* of Membranes form'd and distinguish'd into cells like Honey-combs. And in these cells there are very many Glands. He describes them thus (*lib. de Liene cap. 5.*) "In the Spleen, says he, there may be observed numerous bunches of Glands, or if you will, of Bladders or little Bags dispersed all over it, which do exactly resemble a bunch of Grapes. These little Glands have an oval figure, and are about as big as those of the Kidneys: I never saw them of other colour than white; yea though the Blood-vessels of the Spleen be fill'd with ink, and play about them, yet they always keep the same colour. Their substance is membranous as it were, but soft and easily crumbled; their Cavity is so small that it cannot be seen, but it may be guessed, in that when they are cut they seem to fall into themselves. They are almost innumerable, and are placed wonderfully in the aforesaid cells of the whole Spleen, where vulgarly its *Parenchyma* is said to be; and they hang upon fibres arising from their case, and consequently on the utmost ends of the Veins and Arteries, yea the

Substance.

Situation. It is seated in the left *Hypochondrium* opposite to the Liver : (so *Hippocrat.* 6. *Epidem.* calleth it the left Liver ; and *Aristot.* 3. *de histor. animal.* 7. the bastard Liver) betwixt the Stomach and that end of the Ribs next the Back ; in some higher, in others lower : but naturally it descends not below the lowest Rib. Yet sometimes its Ligaments are so relaxed, that it reaches down lower, yea sometimes quite break, so that it slips down into the *Hypogastrium* : so *Riolanus* tells the story of a Woman that was troubled with a Tumour there, which was taken by her Physicians for a Mole, but dying of it, and being opened, it was found to be occasioned by the Spleen fallen out of its place and lying upon the Womb.

Whether it may be cut out of the body with safety.

And as it very much endangers life when it falls out of its place, so can it not without great danger be quite cut out of the Body, whatever some have boasted of. For how can one imagine that a part so difficult to come at, and that has such large vessels inserted into it, (not to mention its use) can with safety be taken out of the Body ? Wounds in it are commonly mortal ; inflammation, or but obstructions in it do grievously afflict the Patient and sometimes kill him : sure then the total ablation of it must be very fatal. And yet (among others) the ingenious *Brunnerus* in the preface to his above-cited book affirms, that he first took the Spleen from a Dog, and at some distance of time by a second operation cut out the greatest part of the *Pancreas* from the same, and yet he continued to eat and drink, shit and piss, and run about as briskly as if he had wanted neither of them, till about three months after the last operation he was lost in a crowd. But of this more by and by when we come to the use of the Spleen.

It

It is tied to five parts; its upper part to the Midriff (commonly) and its lower to the left Kidney by thin Membranes; by its hollow part which giveth way to the Stomach being distended, to the upper membrane of the *Omentum*, and to the Stomach by sundry vessels. Its gibbous or arched part is knit to the *Peritonæum* by thin membranes.

The *substance* of it is flaggy, loose and spongy, commonly held to be a concrete sanguineous body, serving to sustain the vessels that pass through it: but *Malpighius* with his Microscope has discover'd it to be a *Congeries* of Membranes form'd and distinguish'd into cells like Honey-combs. And in these cells there are very many Glands. He describes them thus (*lib. de Liene cap. 5.*) "In the Spleen, says he, there may be observed numerous bunches of Glands, or if you will, of Bladders or little Bags dispersed all over it, which do exactly resemble a bunch of Grapes. These little Glands have an oval figure, and are about as big as those of the Kidneys: I never saw them of other colour than white; yea though the Blood-vessels of the Spleen be fill'd with ink, and play about them, yet they always keep the same colour. Their substance is membranous as it were, but soft and easily crumbled; their Cavity is so small that it cannot be seen, but it may be guessed, in that when they are cut they seem to fall into themselves. They are almost innumerable, and are placed wonderfully in the aforesaid cells of the whole Spleen, where vulgarly its *Parenchyma* is said to be; and they hang upon fibres arising from their case, and consequently on the utmost ends of the Veins and Arteries, yea the

"ends of the Arteries twist about them like the
 "Tendrils of Vines, or clinging Ivy.——Each
 "bunch consists of seven or eight.] Thus he.

Mem-
 brane.

It is covered with a *Membrane* borrowed from the *Peritonæum*, which is thicker than that of the Liver. First because the Spleen hath a looser substance. Secondly, because it hath more Arteries, which require a strong Membrane to sustain their beatings. *Diemerbroeck* says, it has two Membranes; one from the *Peritonæum* which is outer and common; the other inner and proper, arising from the outer Membrane of the vessels entering the Spleen, interwoven with a wonderfull texture of Fibres; and that betwixt these two the *Vasa lymphatica* run, of which afterwards.

Fibres.

From the inner membrane (according to *Malpighius*) spring innumerable fibres, which run across the Spleen to the opposite part of the same membrane, or to the *capsula* or common case of the vessels, which runs through the middle of the Spleen. They keep not the same plane, but ever and anon being split into two, they each inosculate with others in like manner divided, and make a sort of Net-work. The Ancients believed them to be twigs of blood-vessels; Dr. *Glisson* supposes them also to be vessels, but that they contain not blood but nervous juice: But *Malpighius* concludes them to be onely fibres, as having no discernible cavity, and also because both *Spigelius* and himself have observed the inner membrane of the Spleen, which affords rise and insertion to them, and is framed of a *plexus* of such like fibres, to become bony and sometimes cartilaginous, which he thinks cannot easily agree with the nature of vessels.

It

It hath *Vessels* of all kinds; as 1. *Veins* from the *Vessels*.
Ramus splenicus of the *Vena portæ*. The *Ramus* 1. *Veins*.
 before it enter the Spleen has two Coats, but in
 its entrance its outer and thicker is received by
 the inner coat of the Spleen, which (according
 to *Malpighius*) turning back enters into it, and
 becomes a *capsula* or common cover for both
Veins, *Arteries* and *Nerves*. And whereas *Ana-*
tomists did formerly teach, that this *Vein* upon
 its entrance into the Spleen did presently divide
 it self therein into sundry branches, and so was
 all equally obliterated in its membranes and *Pa-*
renchyma: he affirms, that there is formed out
 of it a large venous duct or *sinus*, that runs quite
 through the Spleen (somewhat like that in the
Pancreas) into which the blood (howsoever al-
 ter'd) is received through the glands from the
Arteries: And because he could never trace the
Veins so far as the Glands, he believes that the
 blood, &c. is conveyed into the afore said venous
 duct by such-like *tubuli* or pipes as the milk is sto-
 red up in and issues out of in Womens breasts:
 and that by making some stay in these, it acquires
 some new mixture and alteration. That there
 are such *tubuli*, appears from his own observati-
 on (and from Dr. *Glisson's* before him) that the
Veins (especially the venous duct before mentio-
 ned) have abundance of little holes or pores in
 their sides, which are extended into the *Paren-*
chyma of the Spleen, and constitute these little
 pipes.

This *Vein* enters the Spleen sometimes in one
 and sometimes in more branches: but whether
 they be one or more, they have each one a *Valve*,
 which looks from the Spleen outwards, permit-
 ting the humours to flow from the Spleen to the

Ramus Splenicus, but hindering them from returning back. And though one cannot discover any anastomoses of the Veins with the Arteries in the substance of the Spleen, yet there is one notable one of the Splenic artery with this *Ramus Splenicus* before it enter the Spleen. Whose use must be, partly to further the motion of the humours contained in the *Ramus* towards the Liver; partly that the superfluous plenty of Blood, which perhaps cannot pass quick enough through the narrow passages of the Spleen, may return back again by help of this anastomosis, through the *Ramus* to the Liver. There are also two Veins that open into the *Ramus* at a little distance from the Spleen; the one called *vas breve* (but should rather be called *vasa brevia*, there being for the most part several which ariseth out of the Bottom of the Stomach. (The error of the Ancients as to the use of this Vessel was detected before, chap. 12. and its true use declared :) and the other the internal Hemorrhoidal.

2. Arteries.

It hath two Arteries, entering one at its upper, the other at its lower part. These commonly spring from the left Coeliac branch, which is called the *Splenic artery*; but sometimes (saith *Diemerbroeck*) from a certain branch which ariseth out of the very trunk of the *Aorta*, and proceeds by a bending passage along the side of the *Pancreas* to the Spleen, approaching whereto it is divided into two, and these branches entering it as aforesaid, they are subdivided through it into a thousand twigs, the most of which terminate in the oval glands above described, and the remainder are spent partly on the membranes that make its cells, and partly on the outer coat, as may be made to appear by filling this artery with ink or air.

Nerves

Nerves it hath from one of the mesenterical 3. *Nerves.* branches of the Intercostal pair, which are not all spent on its investing Membrane (as has been thought) but some enter into its substance, which yet has a very dull sense; but that proceeds not from defect of Nerves (for it has a pretty many Twigs) but probably from that *stupor* or numbness which that acid juice that is bred in the Spleen, may be conceived to induce upon them.

Malpighius in his accurate Anatomy of the Spleen hath found out a considerable membrane not observed by former Anatomists, which from its cleathing or inclosing the blood-vessels and Nerves, he calls a *common case* or *capsule*. It has its rise from the inner and proper investing membrane of the Spleen (as was said before in the description of the Veins) which being turned back in the ingress of the vessels enters to within the Spleen, and being formed into a pipe accompanies the branching of the vessels which are inclosed in it. It has such like holes in it as the Veins before described: and the fibres of the Spleen do most of them either arise from or else are inserted into it. *Their capsule.*

Though Dr. *Wharton* in his *Adenographia*, cap. 4. 4. *Vasa* going about to prove the Spleen to be no Gland, *Lymphatica.* uses this as one argument, that there were never observed any Lympheducts to be distributed through this part; yet *Olaus Rudbeck*, *Fr. Sylvius*, *Malpighius*, *Diemerbroeck*, &c. affirm it to have many, which arising from its conglobate Glands pass through the *Omentum* very plainly into the *Receptaculum Chyli*. See them express in the following figure of a Calf's Spleen.

The Ancients knowing neither the true passage of the Chyle, nor the circulation of the Blood, *The use of the Spleen,* erred grossly as to the use of this part. They thought

thought that it attracted a more seculent and melancholick part of the Chyle, by the *Ramus splenicus*, from the Mesaraick Veins, which having elaborated, it sent it out again partly by the *vas breve*, and partly by the internal hemorrhoidal; but it is certain, that no Chyle, nor indeed Blood passeth by the *Ramus splenicus* to the Spleen, as neither any thing from the Spleen by the above-said Vessels; but whatever they contain comes towards the Spleen, namely into the *Ramus*, and what is in it goes to the Liver. One need add no further reason to evince the error of their opinion; nor that of those that would make it a sanguifying Bowel. Dr. Glisson (in *lib. de Hepate, cap. 45. p. 434.*) thinks it to make an alimentary juice or at least a vehicle for it, which being first imbib'd by its nervous Fibres is from them received into the Nerves, by which it is first carried to the *Glandula renales*; where being refin'd it is received again by the Nerves, and is carried to the Brain and Spinal marrow, and from thence by the Nerves again into all the parts of the Body. We will not here enter into a dispute about the nutritious juice of the Nerves; but supposing it, certainly this seems an odd way of conveying either it or its Vehicle thus to and again by the same sort of Vessels; not to say that so acid a juice as is excocted in the Spleen, one should think would be no very welcome guest to the Nerves, nor be suffer'd to march so quietly, especially passing against the current of the animal spirits that continually flow from the Brain and Spinal marrow. This opinion therefore we shall pass by as very improbable, having little else to recommend it save the credit of its learned Author.

Dr. Mayow according to his hypothesis, that
the

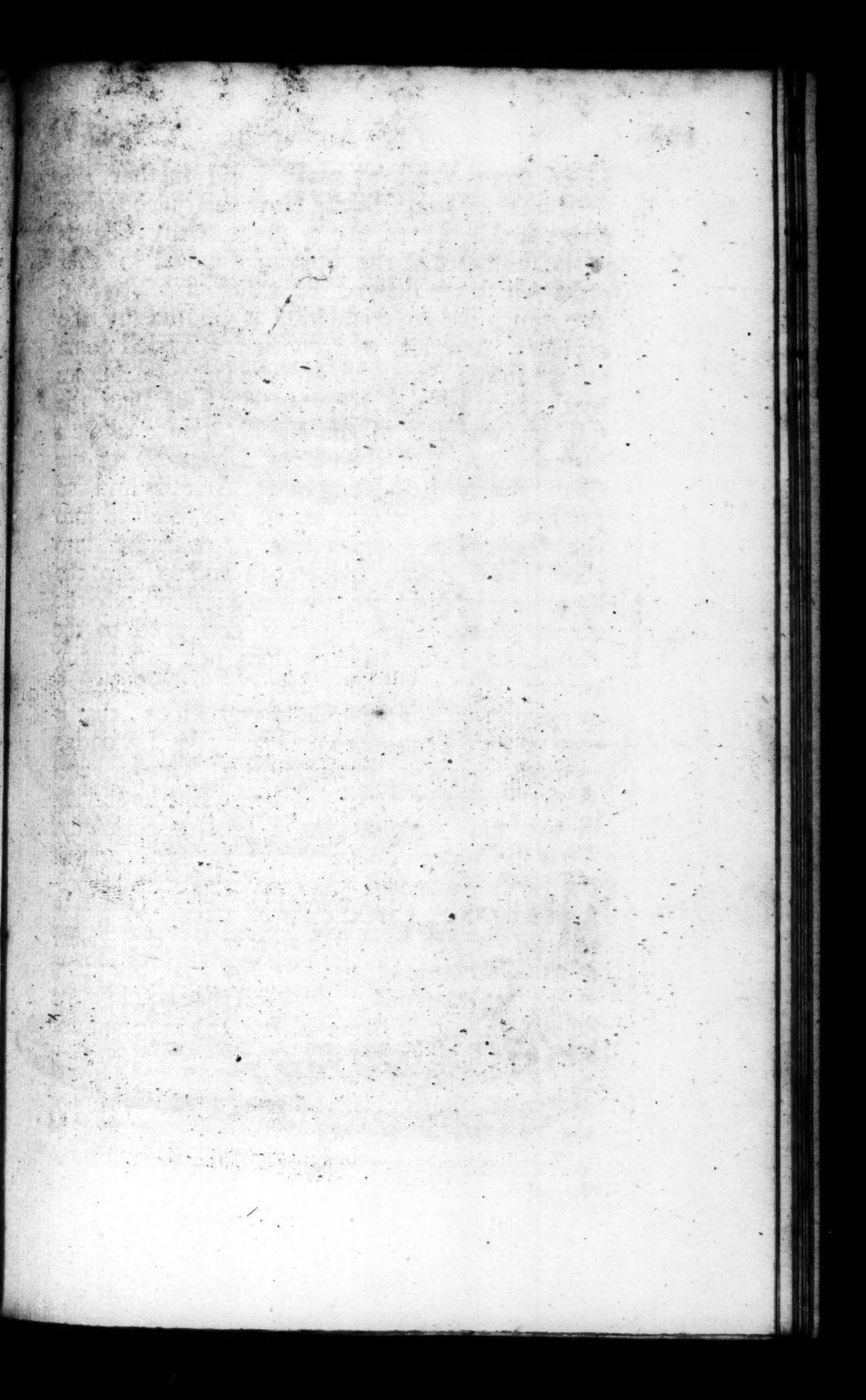
the ferment of the Stomach consists of nitro-aereal particles supplied by the Nerves, and that the ferments in all the other *viscera* consist of the same, assigns these three uses to the Spleen.

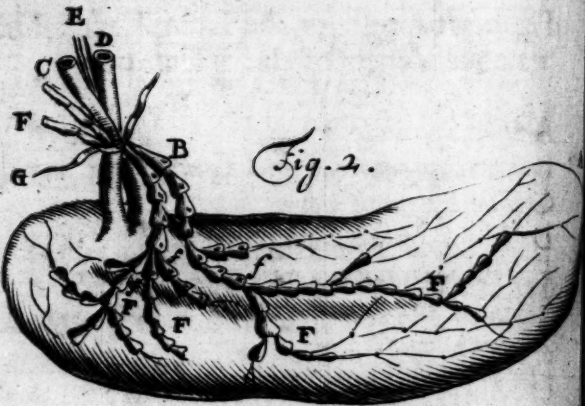
1. That the nitro-aereous particles, which passing through the brain in a continued *series*, are not spent on the natural or animal functions, may be reconveyed (by those Nerves that go to the Spleen, and which have communication with most of those that are bestowed on the *viscera* in the *Abdomen*) into the mass of blood, and rightly mixed with it in the Spleen. 2. That the nitro-aereous particles may be carried in a due plenty and with a certain regimen to the *viscera* appointed for the concoction of meats. For accordingly as those *viscera* are full, or empty of aliment, so they have need of a greater or less afflux of fermentative particles. 3. That the nitro-aereous particles being put in motion and vigour, and intimately mixed with the salino-sulphureous particles of the blood in the Spleen, may excite such an effervescency in the mass of blood, as may be fit to bring its salino-sulphureous particles to a due volatility.] Whence, seeing these offices of the Spleen are not so necessary, but that life may be continued without them, though they much conduce to the right disposition of the Animal Oeconomy and to a perfect health; I say on this account he thinks it not difficult to understand, how it comes to pass that an Animal may live that has it cut out.]

The last (and to me the most probable) use is this, *viz.* That it serves to make a sub-acid and saltish juice of the arterial blood and animal spirits that flow plentifully into it, which passing by the *Ramus Splenicus* to the
Liver

Liver serves there to make (and further the separation of) the Bile. Now this juice is thus elaborated: There are a great many Glands in the substance of the Spleen, disposed in that order which we shewed before from *Malpighius*, into which the Arterial blood is poured by the capillary Arteries, wherewith are mixed some animal spirits deposited into the same Glandules by the ends of the Nerves, which bridling the sulphureous spirit of the Blood, induce on it a little acidity; and then being driven out of the Glandules by the beating of the Arteries and the pressure of the adjacent parts, it is received into the roots of the splenick Vein, (or rather into those *tubuli* before spoken of) and so into the large venous duct, from whence it flows into the *Ramus splenicus*, and by it is conveyed to the *Porta* and Liver. But it does not pass hastily through the Spleen, but seems to make some stay in the abovementioned Cells and Pipes, that it may acquire some more acidity by its stagnating in them: as Wine standing in a Vinegar-vessel sours more and more; and as the Bile by staying in the Gall-bladder gets a greater acrimony. That the Spleen does minister to the action of the Liver (amongst other reasons) may be presumed by this, that the Blood takes so long and tedious a march from that to this by the *Ramus splenicus*, whereas it might readily have been conveyed into the trunk of the *Cava* that is just by the Spleen, if the juice that is elaborated in it had not been for the service of the Liver.

Tab. IV.





Tab. IV. Represents the Pancreas, and the Spleen
with its Lympheducts.

Fig. 1. Represents the Pancreas.

- AA The Parenchyma of the Pancreas opened.
- B The Trunk of the Ductus pancreaticus.
- CCC Its Branches.
- D The Ductus biliaris joining to the pancreatic Duct.
- E The Duodenum opened.
- F The insertion of these Vessels.

Fig. 2. Represents the Lymphatick and Sanguineous Vessels of the Spleen tied.

- A The Spleen of a Calf.
- B The Sanguineous and Lymphatick vessels tied.
- C The Splenick vein.
- D The Splenick artery.
- E The Splenick nerves, whose number is uncertain.
- F The Lymphatick vessels arising out of the outer part of the Spleen.
- ffff The Valves in the said Vessels.
- G The Ligature.

Fig. 3. Represents an Oxe's Spleen, from Dr. Highmore.

- AA The substance of the Spleen covered with its proper Coat.
- B A portion of the Vena porta.
- C Its left, or Splenick branch.
- D This branch opened near the Spleen that the Valve b. may appear.
- EE The

EE The Coat of the Spleen dissected and turned back, that the progress and plexus of the Vessels and Fibres may be shewn the better.

F A portion of the Splenick artery, which running through the whole substance of the Spleen, doth dispense into it the little Twigs aaa.

b The Valve in the Splenick branch looking outwards to the Porta.

ccc The holes which appear in the Ramus splenicus leading from the substance of the Spleen.

ddd Nerves running along the sides of the Splenick artery.

C H A P. XVII.

Of the Kidneys, and the Glandulæ renales.

The Kidneys.
Their denomination.

THE Kidney is called in Latin *Ren*, from *ῥῆναι*, to flow; because the serosity of the Blood doth flow through the Kidneys to the Ureters, and through them to the Bladder. By the Greeks they are called *νεφροί*, *ἡ νεφρῶν*, *mingere*, to make water.

Number.

They are in number two, both because of the great quantity of the serous excrement that is to be separated and discharged by them; and also that one being stopped by a Stone, or otherwise violated, the serum of the Blood might be transcolated by the other.

Situation.

They are seated behind the Stomach and Intestines in the Loins, one on each side of the Vertebra, between the membranes of the Peritonæum; their lower end rests on the head of the Muscle *Psoas*. (which

Chap. XVII. Of the Kidneys, and Gland. Renal. 111

(which is one of the movers of the Thigh) just where the Nerve enters into it, which is the cause that a big stone being in the Kidney, and pressing on the Nerve, a numbness is felt in the Thigh of the same side. In Man the right Kidney is lowest, by reason of the greatness of the Liver, and commonly bigger also than the left; yet it has not so much fat about it as the left, by reason of the vicinity of the Liver, whose heat hindreth the encrease of fat.

In figure they resemble the *Asarum* leaf, or a Figure.
Kidney-bean: towards the Loins or outwards they are gibbous; and also in their ends on the inside; but in the middle where the Vessels enter in and go out, they are hollow. Their surface in grown persons is smooth, but in the *Fetus* and Infants it is very unequal; as may be seen in the following figure of the Kidneys of an *Embryo*.

As for their *connexion*; by the external *Mem-*
brane they are tied to the *Diaphragma*, and the Connexion.
Loins; by the emulgent Vessels, to the *Vena cava*, and the *Aorta*; and by the Ureters to the Bladder. The right hath the *Intestinum cecum* joyn'd to it, and sometimes the Liver; the left hath the Spleen and the *Colon*.

They are in length about five inches, reaching Bigness.
the length of three and sometimes four *vertebrae*; betwixt two and three fingers breadth broad, and one inch thick. In salacious or lustfull Men they are commonly larger than in others.

Their *Membranes* are two. The outer is *common*, borrowed from the *Peritonæum*; within the Membranes.
reduplication of which the whole Kidney is wrapped; and therefore it is called *Renis fascia*, 1. Common.
This membrane is besmeared with much fat; whence it is called *Tunica adiposa*; and into it entereth

with the *Arteria adiposa* from the *Aorta*; as also the *Vena adiposa*, which on the right side commonly ariseth from the Emulgent, seldom from the *Cava*; but on the left, always from the *Cava*. By means of this Membrane 'tis that they are both joyned to the Loins and Midriff; the right, to the *Cecum* and sometimes to the Liver; the left, to the Spleen and *Colon*, as was noted before.

2. *Proper.* The inner is *proper*, and seems to be connate with them, and not propagated from any part. It adhereth very close to them, and has inserted into it small Nerves from the Intercoastal pair, and one twig from that particular branch thereof which goes to the Stomach; whence that consent betwixt the Kidneys and Stomach, that in the pain of the Stone in the Kidneys a vomiting is caused. But these Nerves enter the *substance* of the Kidneys in but very few and those small slips, whence it has but a dull sense. The emulgent vessels as they penetrate this membrane, are said to borrow from it a *capsula* or common cover, (wherein they are both included;) as the Vessels of the Spleen, and the *Porta* and *porus biliaris* of the Liver, do from the Coat of their respective *viscera*, as was shewn above in their description. But * *Bellini* says, that these vessels in the Kidneys borrow their *capsula* from the membranes of the *pelvis*, within which they are dispersed presently upon their entrance into the Kidneys, and springing out of them again run to the cortical or superficial part of the Kidneys clad with a common *capsula* from those Membranes.

* De
struct.
Ren.
p. 59, 60.

Substance. As to the *substance* of the Kidneys (excepting the vascular part) it has been thought by some Anatomists to consist of concrete blood or a *parenchyma*; by others, of a peculiar carnosus substance;
by

by others, that it is of a double nature (because of its different colour;) the outer part, which is of a dull red, to be a peculiar *parenchyma* like that of the Liver; and the inner, which looks paler, to be carnos, but fibrous. But howsoever their *substance* may appear to the naked eye, *Malpighius* with his Microscope hath discovered it to be far other than it has hitherto been apprehended. He says (*lib. de Renibus*): "That the Kidneys in Men are not of one continued frame, but consist of several Globules, as so many distinct Kidneys: That though in grown Men their superficies seems commonly plain, yet it is unequal in Infants new born; and that in adult persons the conjunction of Globules does still appear within from the diversity of colour, which in the several Globules outwardly and towards their sides, whereby they join one to another, is red, but more pale towards their middle. Each Globule consists of alike parts, namely of all those which the whole Kidney partakes of, *viz.* of Bloud-vessels, Nerves, Glands, excretory vessels and a *Papilla* in which the excretory vessels terminate. — If one take off the Membrane from a fresh and as yet soft Kidney, there may by a good Microscope be discovered certain round and very short Bodies roll'd about like little worms, not unlike those that are found in the substance of the Testicles being cut through the middle, or on their surface when their coverings are removed: The way to discover them is to pour Ink upon them, and then gently wipe it off; by the help whereof one may also discern, under the outmost surface, wonderfull branchings of vessels with their Globules (or Glands) hanging at

I

" them,

“ them, like Apples. But for this purpose ’tis
 “ best to inject Ink by the Emulgent Artery ; for
 “ thereby all the branches of the Artery will be
 “ tinged black, and so much of these Glandules as
 “ the capillary Arteries run through. Hereby one
 “ may also discover certain continued winding
 “ spaces and *sinus*’s running through all the outer
 “ superficies of the Kidneys. Then cut the Kid-
 “ ney in at the back lengthways as deep as to the
 “ *Pelvis*, and pour Ink upon it, which gently
 “ wipe off with your fingers end, and you will
 “ see innumerable small pipes running from
 “ the surface towards the *Pelvis* as their centre,
 “ which look something like fibrous or parenchy-
 “ matous flesh, but are indeed membranous and
 “ hollow ; which pipes make up a great part of
 “ the substance of the Kidneys, and are the ex-
 “ cretory Vessels of the Urine. But if you would
 “ plainly discover these *tubuli*, you must have a
 “ special care (in cutting of the Kidney in two)
 “ that you cut streightways of them, and not
 “ sloping, for then you cut them in two, and so
 “ cannot trace them in their progress. From
 “ the Glands into which the extremities of the
 “ Arteries end, the roots of the Veins arise, and
 “ he thinks that the Nerves reach to them too ;
 “ and that it is probable that the excretory ves-
 “ sels of the Urine are extended so far also, seeing
 “ this is constant in all Glands, that every little
 “ Globule has besides the Arteries and Veins, a
 “ proper excretory Vessel, as the Biliary in the
 “ Liver, &c. And he has observed that those
 “ same Pipes or Urinary fibres running streight
 “ from the Glands towards the *Pelvis*, do many
 “ of them terminate into one of the *Papilla*,
 “ through which the Urine is transcolated into
 “ the

" the *Pelvis*, for into it they jet out.] (These *Papillæ* shall be described by and by.) By this curious and accurate description of their substance, he has greatly dispelled that mist of ignorance that Anatomists hitherto were in concerning it. But to proceed.

The *Emulgent Artery*, springing from the descending Trunk of the *Aorta*, enters the Kidney in its inner and hollow side, being first divided into two; but having entered it, these are subdivided into divers branches, which spreading themselves between the coats of the *Pelvis*, shoot forth into smaller twigs; and these with the like twigs of the Veins borrowing a common *capsula* from thence, (according to *Bellini*, as was observed before) run through the whole substance of the Kidney, and end in the Glands afore-mentioned. By this Artery (being large) is much blood conveyed to the Reins, partly to nourish them, but chiefly that in their Glandules a good part of the *Serum* may be separated from it, which being carried by the Urinary fibres or pipes to the *Papillæ* ouzes through them into the *Pelvis*.

The *Emulgent Vein* is a little larger than the Artery. It has the like branching within the Kidney as the Artery; and its trunk coming out hard by where the Artery enters, opens into the *Cava*, into which it discharges the Blood remaining from the nourishment of the Kidney, now freed from a good quantity of *Serum* in the Glands. For that there passes nothing by this Vein to the Kidney is plain, as from the general office of Veins, which always carry from the part where their Capillaries are spread (excepting the *Vena portæ*, which indeed has the office of an Artery) so from that notable Valve that is placed at its

*Emul-
gents.
1. Arte-
ries.*

2. Veins.

entrance into the *Cava*, looking towards it from the Kidney, so that the Bloud may freely pass out of the Emulgent into the *Cava*, but not back again. The Emulgent Vein sometimes comes divided out of the Kidney, as the Artery goes in; but both the branches are presently united into one, and it always opens by one orifice into the *Cava*. The left Emulgent Vein is somewhat higher up than the right, according to the situation of the Kidneys themselves, of which the left stands a little higher.

Of the *Nerves* we have spoken before, discoursing of the proper Membrane of the Kidneys; and as to *Lympheducts* though some Authors mention them, yet none has yet described their number or progress, and therefore I shall pass them by.

The Pelvis
and Pa-
pillæ.

Within the Kidney there is a membranous Cell or Sinus, called *Pelvis* or *Infundibulum* (i. e. the Bason or Tunnel) which is nothing but an extension or dilatation of the head of the *Ureter*; for it consists of the same membranes and nervous fibres with it. It has certain Appendices which run in betwixt the *papillæ*, which are extended into membranous *fimbriæ*, and these parting into numerous fibres run towards and are inserted into the proper coat of the Kidneys, and serve to strengthen their substance and to make it more compact, so that it is not easily violated even by the most violent motions and contortions of the Loins where the Kidneys are seated. The cavity of the *Pelvis* is not round, but branches it self out into eight or ten open and large Pipes. Into it does the *Serum* issue from the Urinary siphons through the *Carunculæ Papillares* or *Mammillares*, for one of these stands at the head of each of the said eight

or

or ten Pipes, (being of an equal number with them) and are like Glandules, of a fainter colour but harder than the rest of the *Parenchyma*; they are about as big as a Pease, flattish above, but round or bunching out on that side next the *Pelvis*; their perforations are exceeding narrow, so that they will hardly admit the smallest hair. Each one is the centre to all the urinary *tubuli* in one globule of the Kidneys; and through them does all the Urine ouze into the *Pelvis*; and none through any pores of the *Pelvis*, as some heretofore have imagined.

The action of the Reins is to separate and evacuate the serous humour from the Blood, which, as was said, is brought to them together with the Blood by the Emulgent Arteries; which is done in this order. After the two branches of the Emulgent Artery are enter'd the Kidneys, they are presently each of them divided into four or five, and those again into many more, till at last they end in the smallest Capillaries which terminate in the Glandules towards the outer superficies, whereinto they infuse their liquor. Into the same Glandules are inserted also the Capillary veins, and the Urinary siphons, each of which imbibe thence their proper liquor. By the Veins the Blood returns into the larger branches of the Emulgent Veins, from thence into the single Trunk, and by it to the *Cava*, which conducts it to the Heart: But by the Urinary pipes does the Serum drill to the *Papilla* or *Caruncula* placed at the entrance into the *Pelvis*, through which it distills into it. And this *Pelvis* being the head of the Ureter, the Serum glides readily out of it down by the Ureter into the Bladder.

The action of the Kidneys.

But now it is very difficult to determine, whether

that this separation of the *Serum* in the Kidneys be procured by any kind of effervescency or fermentation; or whether they serve merely as a strainer, through which it is squeezed or transcolated. If it be separated onely this last way, how admirable is the configuration of the Pores, that the *Serum* with all its contents should pass by them without the least drop or stain of blood, when yet often purulent matter brought out of the *Thorax*, and thoroughly mixed with the Blood, and which is far thicker than the Blood it self, passes through them with the *Serum*, and not any thing of Blood at the same time! That such purulent matter passes by Urine, is frequently observed; but whether it be absorbed out of the Cavity of the *Thorax* by the mouths of the Veins gaping into it, as the Ancients thought it might, or it be bred in the *Parenchyma* of the Lungs apostemating, as is more probable, is not a fit place here to inquire. As neither would it signify much to give you the conjectures of some learned Men, that because such Pins, and much more because Pins, Needles, an Iron nail, &c. have passed by Urine; that therefore there must be some more direct and patent way for part of the *Serum* to be convey'd by to the Bladder; and therefore have imagined that some Lacteals have been inserted into the Bladder, as others have supposed other ways: for as far as could ever be discover'd by Anatomists, there is no footstep of any such passage, how plausible soever such an *Hypothesis* may seem. And therefore we shall say no further of it. As to the fermentation whereby some suppose the *Serum* to be separated from the Blood, those who are for it affirm that a ferment is sent for this purpose from the *Glandule renales*,

to be described presently.) But this cannot be omitted, seeing there appears no way whereby such ferment can be communicated, as shall be further shewed by and by. And the want of such way may serve for a refutation of that other opinion which supposes the humour collected in the *Glandulae renales* to perform the office of a *coagulum* or Runnet to the blood in the Kidneys; whereby the *Serum* is separated from it like they from milk.

Some have thought the Kidneys to have other actions besides the separating of the *Serum*; as further to elaborate the Blood, to prepare the seed, &c. But these opinions are grown obsolete, and therefore rather to be neglected than examined.

Above each Kidney at about half an inch distance there stands a Gland, by some called *Glandula renalis*; by others *Ren succenturiatus*; by Bartholin, *Capsula atrabilaria*; by Dr. Wharton, *Glandula ad plexum nervorum sita*. Which several names they have had given them, from the several uses the Imposers have ascribed to them.

They are commonly but two, and are placed over (but towards the inside of) the Kidneys, having the fat about the Kidney coming between. The left is nearer to the Diaphragm, standing higher than the right, but the right is nearer to the *Vena cava*.

They are seldom of the shape of the Kidneys, but are of not much an unlike substance. Their figure is often three corner'd, having the shape of a Satchel with its bottom upward. Sometimes they are oval but flattish.

They are bigger in Children proportionably than in adults.

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They are bigger in Children proportionably than in adults.

than in Men ; for in the former they are near the bigness of the Kidneys (as may be guessed by the following figure of the Kidneys and these Glands in an Embryo ;) but they do not increase as other parts do, so that in adult persons they are not above two inches long and one broad. Commonly the right is bigger than the left.

Membrane.

They are covered with a thin *Membrane*, which is knit very fast to the outer or adipose *Membrane* of the Kidneys.

Cavity.

They have a manifest *Cavity* in their larger end, in which is contained a black and feculent humour, that tinges the sides of the *Cavity*. Into it there are a great many little holes gaping out of the substance of the Gland, according to Dr. *Wharton* ; and it self opens into a Vein, but has a Valve placed just at the entrance, that permits the humour contained in the *Cavity* to flow out by the Vein, but hinders its return.

Vessels.

They have *Veins* and *Arteries* commonly from the Emulgents, sometimes from the *Cava* and *Aorta*, and sometimes from the *Vasa adiposa*. Their *Nerves* come from the stomachick branch of the Intercostals, that runs to the proper *Membrane* of the Kidneys and to the Spleen also. *Lacteals* they have none. *Bartholin* affirms they have *Lymphaticks*.

Use.

There have been divers conjectures of the use of these Glands, but none generally consented to as true. Dr. *Wharton's* guess is, that some humour is imbib'd from the Spleen by the Nerves that are common to the Spleen and these Glands (being both from one branch) and is deposited in their *Cavity*, which being not purely excrementitious (though perhaps unprofitable to the Nerves) is restored again to the Veins,

as being of some use to the venal blood. Dr. *Glisson* also thinks they receive something from the Spleen, which being refin'd here is imbib'd again by the Nerves, by which it ascends to the Brain or Spinal marrow, and descends again by them, being either it self a *Succus nutritius*, or else a Vehicle for it. *Riolanus* thinks they are of no use at all in Men, but onely in the *Fœtus* in the Womb. *Veslingius*, *Bartholin* and many others think that they make a ferment, or *Coagulum* for the use of the Kidneys to help the separation of the *Serum* from the Blood. And this indeed were a probable use if there could be found out any way whereby ought could conveniently pass from hence to the Kidneys. But the Veins that go out of them are inserted either into the Emulgent vein or into the *Cava*, whose Blood is flowing from the Kidneys, so that it cannot pass to them, unless one would suppose a contrary course of humours in the same Vessel, which seems absurd. And there are no other Vessels to serve this turn. *Diemerbroeck* conjectures that their black juice is made of the Arterial blood, and acquires a certain fermentative power necessary for the Venous blood, into which it is received by the *Cava* from the Veins that go out of these Glandules. But this, says he, is but a conjecture. And in truth all the other opinions are no more, nor very probable ones neither; so that we must still acknowledge our ignorance of their true use.

Tab. V.

Fig. 1. Represents a Kidney cut in two length-ways, from the Back to the Pelvis.

- AA The glandulous part of the Kidney.
 BB The Tubuli urinarii or Siphons which convey the Urine separated by the Glands, into the Pelvis C.
 D The mouth of the Ureter.

Fig. 2. shews the aspect of a Kidney cut length-ways from the Ureter to the Pelvis, from Bellini.

- AAA The Kidney dissected as is said.
 B Half of the Ureter bent toward the right hand.
 C The other half of the Ureter bent to the left hand.
 D A branch of the Emulgent Vein.
 E A branch of the Emulgent Artery.
 F The Pelvis opened.
 GG Some of the Papillae, through which the Urine issues into the Pelvis.
 I. The beginning of the Ureter.

Fig. 3. Representeth the Kidneys and Capsula Renales in the same proportion as they appeared in an Abortion supposed to be about five months old, communicated to me by Dr. E. Tyson.

- AA The Glandulae Renales, which were rather bigger than the Kidneys themselves.
 BB The Kidneys, whose surface is very uneven, being divided into several bodies as a Bullock's Kidney is.
 CC The Emulgent Vessels, DD The Ureters.

fig. 1.

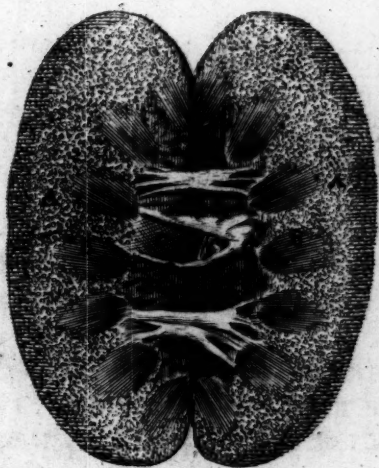


fig. 2.

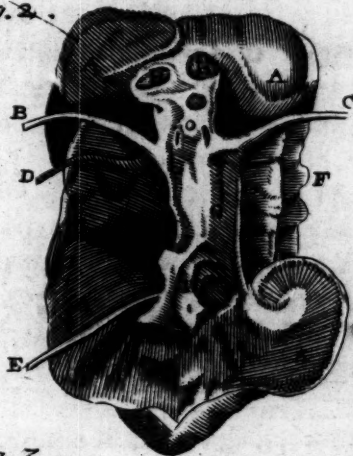
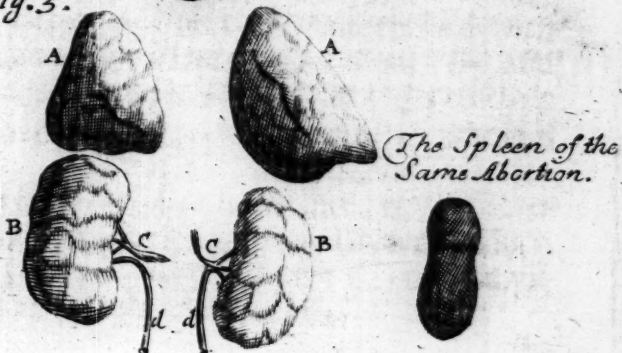
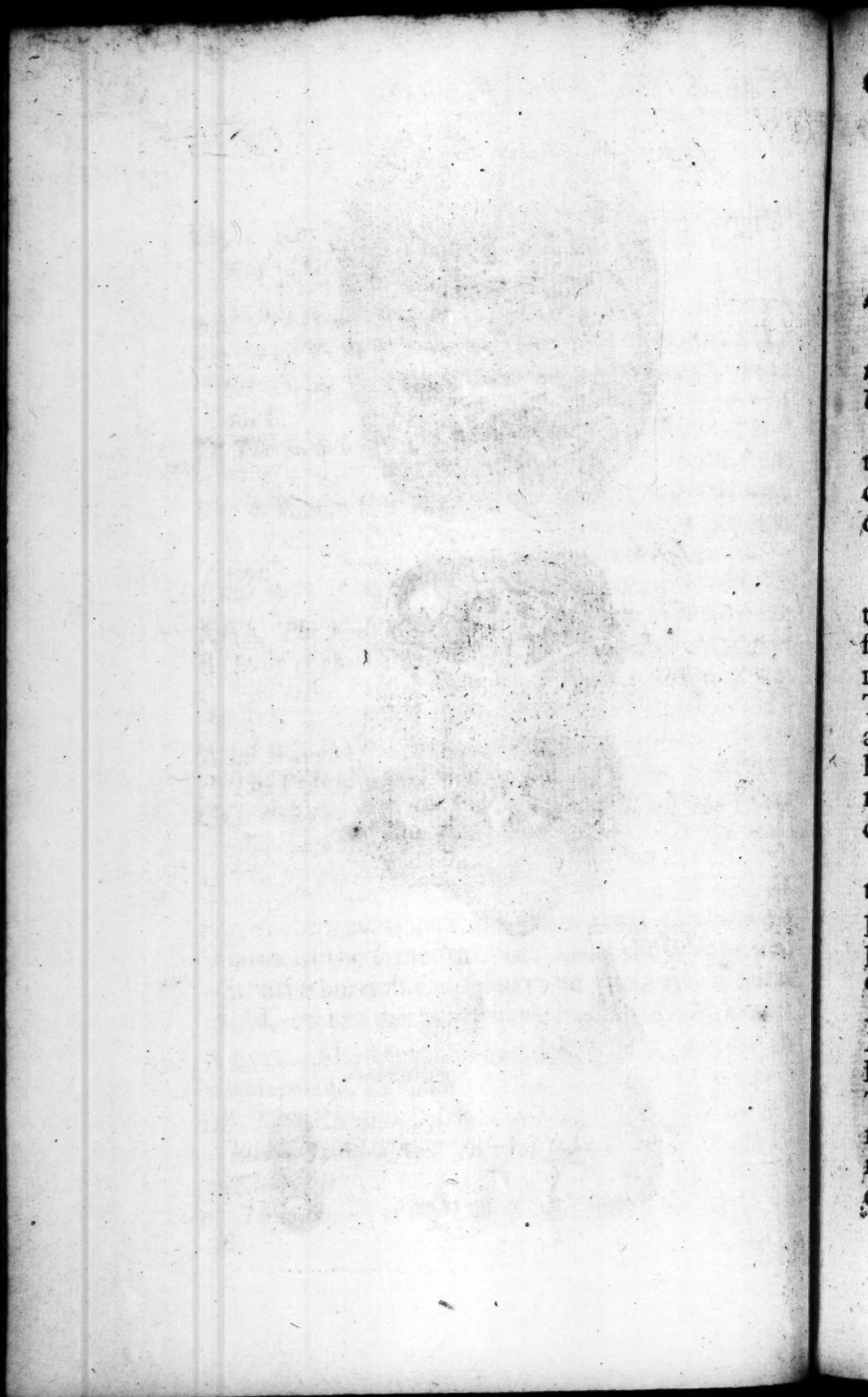


fig. 3.





C H A P. XVIII.

Of the Ureters.

THE Ureters, in Latin *Mediæ urinaris*, are The Ureters, called in Greek *ὑδῆρες*, either from *ὕδωρ*, *ters*. to piss, or *ὑδρὸν ἡγεῖται*, because they keep the Urine.

They arise out of the inner *Sinus* or *Pelvis* of Their origin the Kidneys, coming out on their inner or *concave* side contiguous unto (but on the under side of) the *Emulgents*.

There is one in each side.

They are somewhat like to Veins, but whiter, thicker and more Nervous. They reach from the Kidneys to the Bladder, not in a direct line, but something crooked like an Italic */*. They are a little above a span long, and as thick as a Barley straw naturally. But in such as have had large Stones descend by them from the Kidneys to the Bladder, they have sometimes become almost as wide as a small Gut.

They have been thought to have two Coats, Coats and the one common from the *Peritonæum*; the other Vessels. proper: but indeed they have but one, and that proper. It is strong, nervous, and endued with oblique and straight Fibres, having small Veins and Arteries from the neighbouring parts. As to their Nerves Dr. Willis saith, that after the Intercostals have sent forth all the Mesenterick Nerves, each Trunk descending sends forth three or four several slips that are carried into the Ureters, which makes the pain so very exquisite when some viscid matter or stone sticks in them.

As

*Passage
and inser-
tion.*

As they go out of the Kidney they pass over the Muscles *Psoæ* (which bend the Thigh) between the two Membranes of the *Peritonæum*, and descending as abovesaid, they are inserted in the lower side of the Bladder, (near its neck) running between its two proper Coats about the length of an inch, and continued with the inner.

*Why the
insertion is
oblique.*

This insertion is thus oblique, to hinder the regurgitation of the Urine, when the Bladder is either distended with Urine or compressed in making water; for here is no Valve, as some have affirmed.

Use.

Their use is to receive the Urine separated from the Blood in the Kidneys, and to convey it into the Bladder, thence at discretion at certain times to be emptied out of the Body.

Tab. VI. shews the Liver, Kidneys, Bladder, Testicles, &c.

AAA The sinuous or hollow part of the Liver.

B The Gall-bladder.

C The Ductus bilarius.

D The Neck of the Gall-bladder.

E The Ductus communis.

F The Umbilical Vein turn'd upwards.

GG The descending Trunk of Vena cava.

HH The descending Trunk of the great Artery.

I The Emulgent Veins.

KK The Kidneys in their natural situation.

LL The Emulgent Arteries.

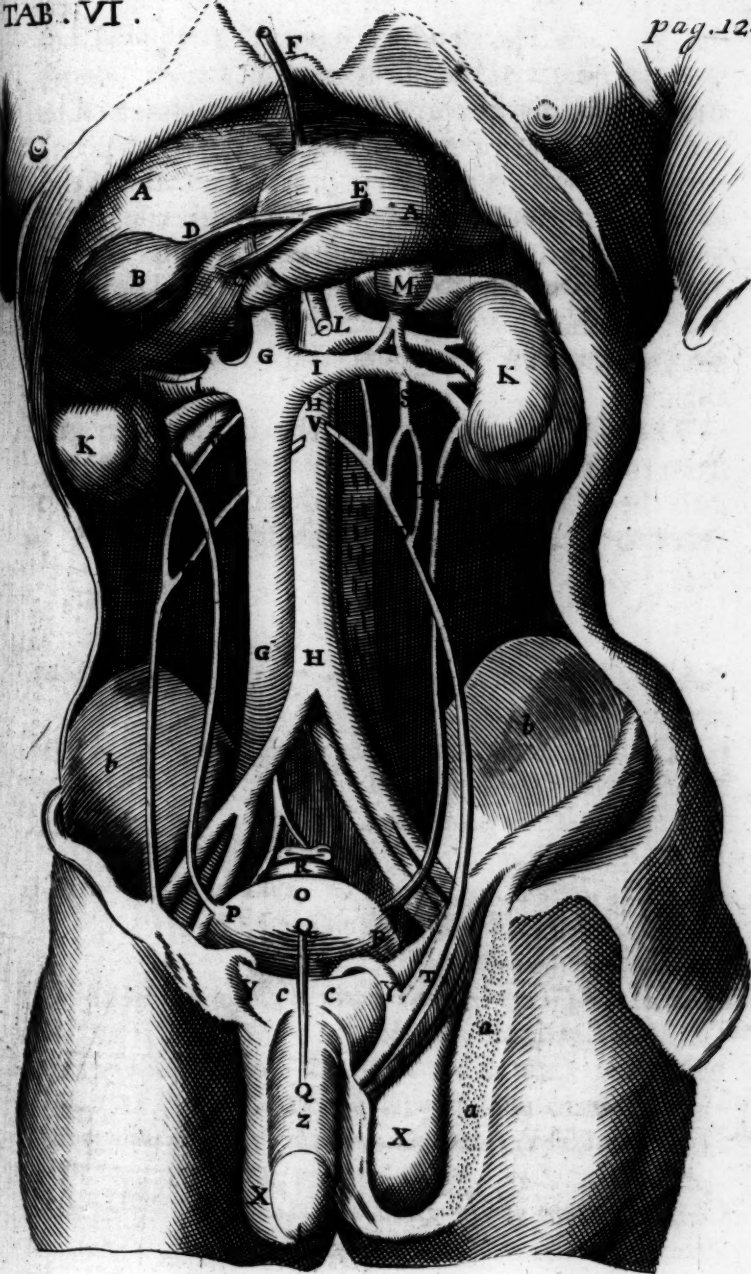
MM The Glandulæ Renales with the Veins that go from them to the Emulgents.

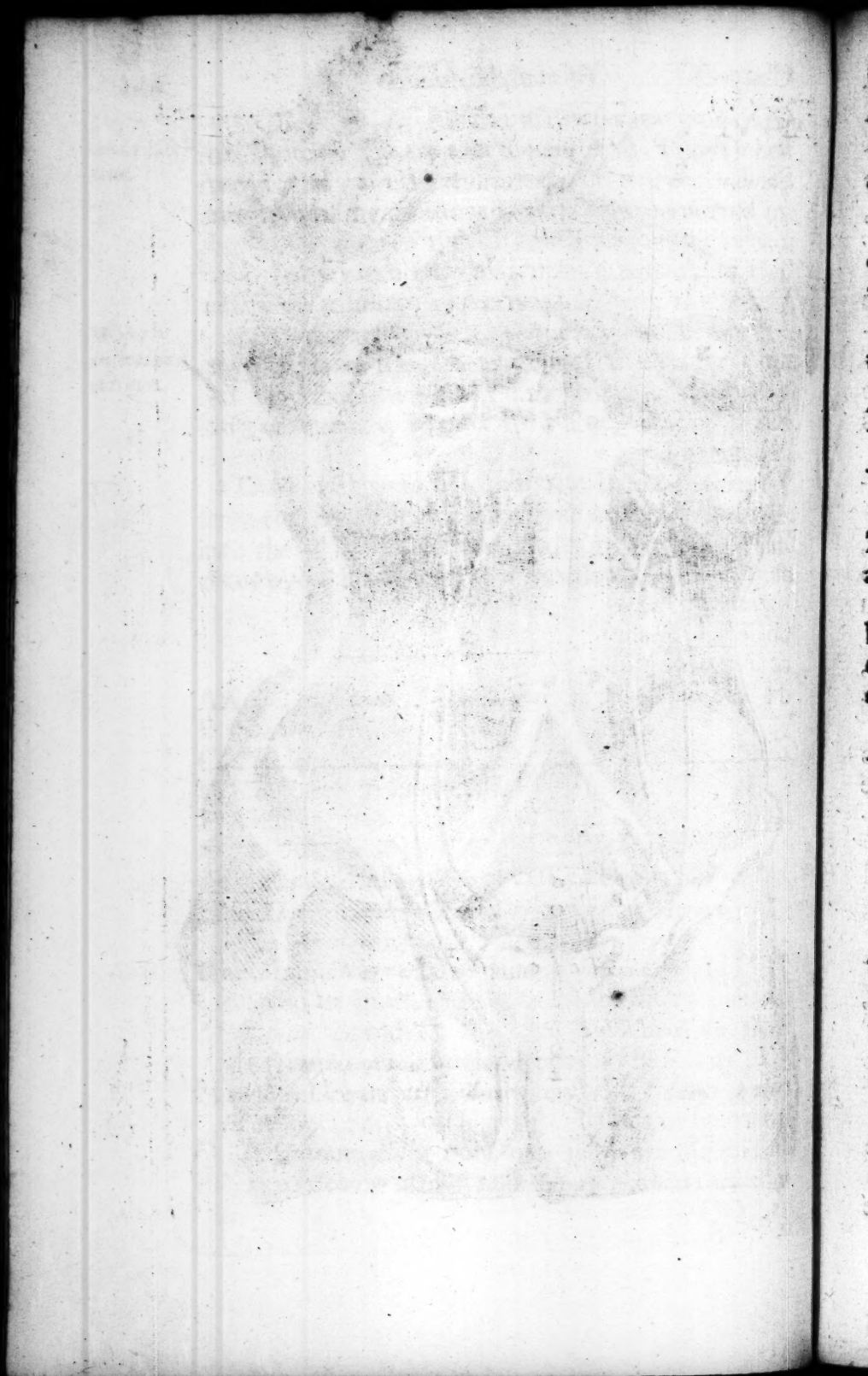
NN The Ureters descending from the Kidneys to the Bladder.

O The bottom of the Bladder.

PP The insertion of the Ureters into its sides.

QQ A





QQ A portion of the Urachus.

R A portion of the streight Gut cut off.

SS The Venæ præparantes, the right whereof springs out of the trunk of the Cava; the left out of the Emulgent Vein.

T The Corpus pyramidale exprest on the left side.

V The rise of the Arteriæ præparantes out of the trunk of the Aorta.

uu Their reception into one common cover with the Veins.

XX The Testicles, the left whereof is divested of its common Coat.

YY The Vasa deferentia, ascending from the Testes to the Abdomen.

Z The Yard.

aa The Cod, that cover'd the left Testis, separated from it.

bb The Ossa ilia.

cc The Ossa pubis.

dd The Loins.

C H A P. XIX.

Of the Bladder.

THE Bladder is called in Latin *Vesica urinae*. The Bladder, in Greek *κύστις ὑποβλυστική* from its office of receiving the Urine. Its name.

It is seated in the *Hypogastrium*, betwixt the two Coats of the *Peritonæum*, in that Cavity that is formed of the *Os sacrum*, Hips, and *Ossa pubis*, and is called *Pelvis*. In Men it lies upon the *Intestinum rectum*; in Women it adheres to the neck of Seat and connexion

of the Womb, which is placed betwixt the Bladder and the straight Gut: in both it is knit before to the *Ossa pubis*. Moreover it is knit to the Navel by the *Urachus*, and, according to some, by the Umbilical Arteries.

Its substance is made up of three *Membranes*.

Membranes.

The first and outmost is borrowed from the *Peritonæum*. *Riolanus* says, this coat is a duplication of the *Peritonæum*, within which the Bladder lies hid suspended like a bottle turned the mouth downwards. On its outside in Man it is besmeared with fat, but not in Beasts.

The second is thicker, and endued with carnos Fibres; yea *Aquapendens*, *Spigelius*, *Walæus* and *Bartholin* will have it to be a true Muscle, serving for the compression of the Bladder, to squeeze out the Urine, as the Sphincter serveth for constriction, to retain it.

The third and innermost is white and bright, of exquisite sense, as those can witness who are troubled with the Stone.

Crust.

Within, it is covered with a slippery mucous Crust, which is reputed an Excrement of the third concoction of the Bladder. This doth defend it from the acrimony of the Urine.

Fibres.

Its membranes have all sorts of *fibres*. And when these membranes and fibres are too long or too far extended with plenty of Urine, they lose the power of contracting themselves, so that there insues a stoppage of Urine, whereby pain, inflammation and other symptoms are caused.

Perforations.

It is perforated in three parts, *viz.* in the Sides, where the Ureters are inserted, to let in the Urine; and before, to let it out.

Parts, viz.

It hath two parts, to wit, the Bottom and the Neck.

The

The *Bottom* comprehends the upper, wider *Bottom* and more membranous part of the Bladder, to which the *Urachus* being tied reaches the Navel, which, together with the bordering Umbilical Arteries, becomes a strong Ligament in the adult, hindring the Bladder to press upon its Neck. But as for the Arteries, *Riolanus* * affirms, * *In anim.* that they contribute nothing to the suspension of *made. ad* the Bladder, neither reaching to the Navel in *Bauh.* the adult, nor touching the body of the Bladder. Of the *Urachus* see after, chap. 33.

The *Neck* is lower than the bottom, and *Neck* straiter. In Men it is longer and narrower, and being carried to the rise of the Yard opens into the *Urethra*; in Women it is shorter and wider, and is implanted into the upper side of the Neck of the Womb; In both it is carnosus and muscular, woven of very many Fibres, especially transverse or orbicular, which lie hid within the straight Fibres that surround the whole body of the Bladder, and these make the Sphincter, which constricts the neck of the Bladder so, as no Urine can pass out against ones will, unless when it is affected with the Palsie or other malady, by which there sometimes happens an involuntary pissing. As the Neck opens into the *Urethra*, there is hung before it a little Membrane like a Valve, which hinders the flowing of the Seed into the Bladder, when it is emitted into the *Urethra*. This Membrane is violated by putting up a Catheter into the Bladder, and sometimes corroded by a *Gonorrhoea*.

The Bladder is oblong, and round, in *shape* *Figure* like unto a Pear.

Its *Cavity* is but one ordinarily; yet some *Cavity* times it has been found to have a membranous par-

partition, that divides it into two ; which yet had a hole in it for the communication of one Cavity with the other. Such a partition was observed in the Bladder of the Great *Casaubon*.

Vessels.

It hath *Arteries* and *Veins* from the *Hypogastrica*, which are inserted into the sides of its Neck, where they are immediately branched into two, whereof one is spent upon the neck, and the other on the bottom. *Nerves* it hath (according to *Dr. Willis*) from the lowest *Plexus* of the *Intercostals* in the *Abdomen*, and from the Marrow of *Os sacrum*. For the said *Plexus* sending two *Nerves* into the *Pelvis*, they have each of them a *Vertebral* nerve joined to them; and so make two new *Plexus*, from one of which there passes a *Nerve* that, being divided into many branches, is on each side distributed into the Bladder and its *Sphincter*.

Use.

The use of the Bladder is to receive the Urine from the *Ureters*, and to contain it, like a Chamber-pot, untill the time of excretion, when it is squeezed out of it partly by the help of its own carnosus Membrane, and partly of the Muscles of the *Abdomen*.

Observations,

Bartholin quotes some observations of *Borrichius* concerning the Bladder, worthy to be noted, viz. If it be boil'd in acids, it turns into a Mucilage ; if in salt liquors, it is thickned ; if in oleous, or in the liquor of the *Alkali* salts of *Tartar* or *Herbs* burnt to ashes, it is neither thickned nor turns into a Mucilage, but is burnt as if it were laid on burning Coals, and may almost be crumbled to powder. By which, says he, it appears, with what great danger to the Bladder Men inject into it either acid, salt, or oleous liquors, for breaking the Stone.

CHAP. XX.

Of the *Vasa præparantia* in Man.

Hitherto we have handled the parts ministering to *Nutrition*, whereby the Nutriments are prepared in the lower Belly for the sustentation of an individual body (and their Excrements separated, and discharged out of the body;) Now we come to the organs of *Generation*, whereby through procreation is conserved a perennity of Mankind, which Nature hath denied to particulars. These parts being not alike in both Sexes, we must necessarily treat of each apart, and first of those of Men.

In Man some of these parts afford matter for the Seed, to wit, the *Arteria spermatica*; others bring back again the Blood that is superfluous to the making of the Seed and to the nourishment of the Testicles, and these are the *Venæ spermaticæ*; and both these Arteries and Veins were formerly called *Vasa præparantia*: some make the Seed, as the Stones; some convey it from thence to its conservatory or store-house, as the *Vasa deferentia*: some contain the Seed till the time of Copulation, and these are the *Vesiculæ seminales*: some discharge the Seed into the Matrix in coition; this is done by the *Penis*: and some, lastly, moisten the passage, (*viz.* the *urethra*) whereby the Seed issues, and those are the Prostates. Of all which in order. And first of the

*The parts
of the ge-
nitals in
man.*

Vasa præparantia, which are said to prepare Vasa præ-
matter for the Seed. These are of two sorts, parantia.
Arteries and Veins.

K

The

Arteries.

The *Arteries* are two, and spring from the Trunk of the *Aorta*, commonly two fingers breadth under the Emulgents, not from its side but out of its fore-part, the right whereof climbing over the trunk of the *Vena cava*, runs obliquely to the Vein of the same side; as also the left, marches to the Vein of that side.

Veins.

The *Veins* are also two. The right arises usually from the trunk of the *Vena cava*, a little below the Emulgent; the left from the Emulgent itself, for otherwise it must have gone over the *Aorta*, whereby it might have been in danger of breaking; or rather by the continual pulse of the Artery the recourse of the Venal blood might have been retarded. Now both these Veins and Arteries a little after their rise meet, and are invested both in one Membrane made of the *Peritonæum*, and then run straight through the region of the Loins above the Muscles *Psoæ* on each side, and above the Ureters, as they go bestowing little slips here and there upon the *Peritonæum*, between whose duplicature they descend, and so arrive at its processes. The Veins divide very often into many branches, and by and by inosculate and unite again; but the Arteries go along by one Pipe onely, on each side, untill within three or four fingers breadth of the Stones, where each is divided into two branches, the less whereof runs under the *Epididymis*, the larger to the Testicle. And as I said they descended betwixt the Membranes of the *Peritonæum*, so they pass into the *Scrotum* between them, not perforating them in the processes, as in Dogs and other Creatures, wherein the processes of the *Peritonæum* are hollow like a Quill; but in Man the inner Membrane of the *Peritonæum* shuts the hole lest the

In-

Intestins fall by it into the Cod; of which there is greater danger in him (and we see it often happen) because of his going upright. But to return to the *Vasa præparantia*. It has been generally taught that there are divers inosculations of the Arteries with the Veins in their passage, whereby the Venal and Arterial blood are mixed; but this opinion is now exploded, for that, granting the circulation of the Blood, it is impossible. For the Blood in the Arteries descends towards the Testicles, and that in the Veins ascends from them, so that if these two Vessels should open one into the other, the Blood in one of them must needs be driven back, or else, stagnating, distend and break the Vessels. But the truth is, the Blood both for the nourishment of the Testicles and the making of Seed flows down by the Arteries onely, and that in an even undivided course, without any of those windings and twirlings like the Tendrels of Vines talkt so much of, (as the curious *de Graef* by his own frequent inspection testifies :) But the Veins bring back from the Testicles what of the Blood remains from their nourishment and making of Seed, and these indeed come out of their inmost membrane by almost innumerable roots by which they imbibe the said Blood, and are most admirably interwoven and inosculated one with another till about four or five fingers breadth above the Testicle, which space is called *Corpus pyramidale*, *Plexus pampiniformis*, or *Varicosus*; but these Veins are so far from preparing the Seed, as that they onely bring back what was superfluous from the making of it. And indeed the Arteries in Men do no more merit the name of *Præparantes* in respect to the Seed, than the *Gulles* in respect of the Chyle, or the

Ductus therapeutics chyloferus in regard to the Blood; for their blood acquires no sensible alteration till it come to the Testicles themselves. But however, we continue the old names, declaring only against the reason of them. And we will only note two things more. First, that the Spermatick Veins have from their rise to their end several Valves which open upwards, and so suffer the Blood to ascend towards the *Cava*, but not to slide back again. Secondly, that though the Spermatick Arteries go such a direct course in Men, as has been said; yet in Brutes they are more complicated and twisted with the Veins, but without any anastomoses of one into the other.

There are *Nerves* and *Lympheducts*; that accompany these *Vasa preparantia*; of which in the next Chapter.

C H A P. XXI.

Of the Stones, or Testicles, and the Epididymidæ.

The Stones.
Their
name.

THE Stones in Latin are called *Testes*, either because they *testifie* one to be a man, or because amongst the Romans none was admitted to bear *witness* but he that had them. In Greek they are called *μῆτρα*, *μῆτρος*, and also *διδυμοί*, *Twins*, because according to nature they are always two.

They are
principal
parts.

They are reckoned among the principal parts, and that justly; for though they are not necessary to the life of the *Individual*, yet they are, to the

the conservation of the species. Yea and by the loss of them the Individual receives very great prejudice both as to the strength and activity of his body, and as to the acuteness of his reason, &c. according to that of *Avenzoar*, *In Eunuchis males agnoscimus mores, rationis sunt pessimæ, — intellectus diminuti.*

They have a peculiar substance, (such as is not in all the Body besides) whitish and soft, made up of innumerable little ropes of Seed-carrying vessels: there is no Cavity in them; but those said Vessels are continued (and by very thin membranes tyed) to one another, and carry the Seed in their undiscernible hollowness. The way to make these Vessels visible, *de Graef* has taught us: viz. Tye fast the *Vas deferens* in a Live-dog or other Brute, and then these internal Ropes of Vessels, otherways inconspicuous, will presently be so filled and distended with seminal matter, as that they may be easily discerned. *Galen*, *Dr. Wharton* and of late *Peyerus* reckon them amongst the Glands.

They are in number two, hanging without the Abdomen, at the root of the Yard, in the Cod. Their figure is oval, onely a little flattish. Their bigness differs very much in several persons; as big as a Dove's Egg is reckon'd a mean size. *Hippocrates* held the right to be bigger and hotter than the left, and therefore called it ἀρρενικόν, the Male-getter, as the left σπληνικόν, the Female-beggetter. But these are fancies that are obsolete, and indeed seem ridiculous, seeing there is no such difference of their bigness, and that their Vessels are common.

They have Arteries and Veins (as was said before) from those called *Vasa præparantia*. Which some have thought to reach onely to the inmost

Their substance.

Number, Situation, Figure and magnitude.

Vessels.

Coat called *Tunica albuginea*, because they are not conspicuous in the inner substance of the Testicles. But though this may be true of the Veins, which onely receive the superfluous Arterial blood, and have nothing to doe with the Seed; yet it is not true of the Arteries, namely of the most numerous branches of them. Indeed blood is seldom seen in the substance of the Testicles, but that comes to pass by reason that the Arterial blood presently loses its colour, and by the seminisick faculty of the Stones is turned into Seed, which being whitish, of the same colour with the Vessels, makes them undiscernible. Yet in those men that have died of languishing Diseases, and whose *Testes* have their faculty impaired, *Diemerbroeck* affirms that he has oft discover'd Sanguiferous vessels in the inmost parts of the Stones, and has shew'd them to many in the publick Anatomical Theatre. As for Nerves, Dr. *Willis* says he could never observe more to go to them than one from a Vertebral pair; and that too was most of it spent upon the Muscle *Cremaster*. *Diemerbroeck* agrees to one Nerve, but thinks it proceeds from the sixth pair, (which is Dr. *Willis's* Intercostal, as distinguish'd from that commonly call'd the sixth, but his eighth.) Others will have branches from both these Nerves to go to them. Concerning the use of these Nerves there is great controversie. Dr. *Glisson*, *Wharton*, &c. will have them to convey a *Succus genitalis*, which makes the greatest part of the Seed. Dr. *Willis*, as he denies (in *Cerebri anatomic*, cap. 27.) any *Succus nutritivus* to be conveyed by the Nerves to other parts, so that any *Succus genitalis* is brought by them hither, but onely animal spirit. And whet'as to strengthen the

the former opinion 'tis usually objected, That the Seed must needs consist of a nervous juice and plenty of spirits brought from the Brain, because of the great debility and enervation that is induced upon the Brain and Nerves by the too great expence of it: he thus answers, That this comes to pass, because after great profusions of Seed, for the restauration of the same humour (whereof Nature is more solicitous than for the benefit of the individual) a greater tribute of spirituous liquor is required from the Blood to be bestowed on the Testicles: wherefore the Brain being defrauded of a due income and afflux of the said spirituous liquor, languishes; and so the animal spirits failing in the fountain, the whole Nervous system becomes depauperated and flaggy. Where-to may be added, that also the animal spirits themselves that actuate the *Prostates*, being derived from the Spinal marrow, are much wasted by venereal acts; so that for this reason besides, the Loins are enervated.] In this answer *Bartholin* acquiesces. And *de Graef*, *Diemerbroeck*, &c. confess indeed that the spirituous Arterial blood is impregnated with Animal spirits from the Nerves, but affirm that the matter out of which the Seed is elaborated, is onely the said blood; and to these we subscribe. *Lymphducts* they have also arising from betwixt their Coats, and ascending upwards into the *Abdomen* with the *Vasa deferentia*. These have many Valves looking upwards, which hinder any thing from descending by them to the *Testes*, but permit the *Lympha* to ascend, which they convey into the Chyliferous vessels.

They have two sorts of Coats, proper and Coats. common.

The common invest both the *Testes*, and are two. The outermost consists of the *Cuticula* and True skin (here thinner than in other places.) This is called *Scrotum*, hanging out of the *Abdomen* like a Purse. It is soft and wrinkled, and without fat. On the outside it has a Suture or Seam that runs lengthways of the *Cod*, and divides it into the right and left side. The other or inner common Coat is the *Membrana carnosæ*, here also thinner than other-where; this is called *Albuginea*, growing to the proper Coat next under it (called *Vaginalis*) by many membranous Fibres.

The proper Coats are also two, and these enclose each Stone apart. The outer is called *Elytroides*, or *Vaginalis*; because it contains the Stone as a sheath. It is a thick and strong Membrane, having many Veins. In the outside it is uneven, by reason of the Fibres by which it is tied to the *Dartos*; but in the inner side it is smooth. This is nothing else but the production of the *Peritonæum*, even as the *Scrotum* is of the Skin of the *Abdomen*. Into this Coat is inserted the Muscle *Cremaster*, of which presently. The inmost is *ὕλη νεύρωσις*, the Nervous membrane, called *Albuginea*, from its colour. It is white, thick and strong, framed of the external Tunicle of the *Vasa præparantia*. It immediately enwraps the Stone, towards which it is rough, but on the outside next the *Vaginalis* it is smooth; and between these two the water is contained in an *Hernia aquosa*.

Muscles.

Into the outer of the proper Membranes (as was said) is inserted the Muscle *Cremaster*. These Muscles (to each Stone one) have their rise from the *Ossa pubis*; and almost encompassing round the

the processes of the *Peritonæum* descend with them to the Testicles; where their carnos Fibres run through the whole length of this same *Tunica vaginalis*, especially in its lower part, and so keep the Stones suspended, from whence they have their name (from *ἡσπάζω* *suspendo*.) From their spreading themselves thus on the outside of the outer proper coat, *Riolanus* reckons them for a third proper coat, calling it *Erythroides*: and because by its carnos fibres it makes the *vaginalis* look red, such as take it not for a distinct coat do give the name of *Erythroides* also to the *Vaginalis*, calling it by either name indifferently. These Muscles pull up the Stones in the act of generation, that the Vessels, being slackned, may the more readily void the Seed: and at other times they help to sustain their weight.

These Muscles in sickness and old age become flabby, and so the *Scrotum* relaxeth it self, and the Stones hang low.

Upon the Stones, as yet clad with the *Tunica Epididymidæ*, are fixed the *Epididymidæ* (called also *Parastatæ*) enwrapped in the same Coat with the Spermatick vessels. They adhere closer to the Testicles at their ends than in the midst. *De Graef* defines them to be *Vessels making with their various windings that Body that is fixt on the back of the Testicles*. To find out their substance he directs us thus. "First take off the Membrane that encompasses them and knits them to the Stones, and then there will appear many windings, which with the edge of a knife may without hurting the Vessels be so easily separated from one another, that they may be drawn out into a length like a thing folded: for they are onely folded from one side to the other, and are kept

" in that site by the Membrane received from
 " the *Tunica albuginea*, (or *Spermatick vessels*.)
 " But when you have unravel'd half of them you
 " must cut another very thin Membrane, and
 " then you will see other Vessels lie just like these,
 " and may be unloosed like them. And the whole
 " being unravel'd, the thicker they are by how
 " much further from their origine, which is im-
 " planted into the upper part of the Testicle by
 " six or seven ramifications: which having run so
 " far as where they joyn into one duct, make it
 " as thick as a small thread; and this by degrees
 " so thickens, that being increas'd like a cord it
 " makes the *Vas deferens*, (of which in the next
 " Chapter.)

" So that (saith he) it is clear from hence, first,
 " that the *Testes* do not differ from the *Epididy-*
 " *mide* (or *Parastate*) saving that those consist
 " of divers ducts; but these, after their six or
 " seven roots that arise out of the Testicle are
 " united, (which they are in a short space) but
 " of one, onely a little thicker. Secondly, that
 " the *Epididymide* differ not from the *Vasa defe-*
 " *rentia*, saving that the former go by a serpentine
 " winding passage, and these by a streight, and
 " that those are a little softer and narrower. And
 " so (concludes he) following this *Ariadne's*
 " thread we have happily made our way out of
 " the Labyrinth of the *Testes* and *Epididymide*.

Use.

The *uses* of the *Stones* are two :

The first is to elaborate the Seed by the semi-
 nifical faculty resident in them. For they turn
 the Blood, which is brought by the *Arteriae prae-
 parantes*, and impregnated with Animal spirit, into
 Seed, for the most part; some is spent on their

OWD

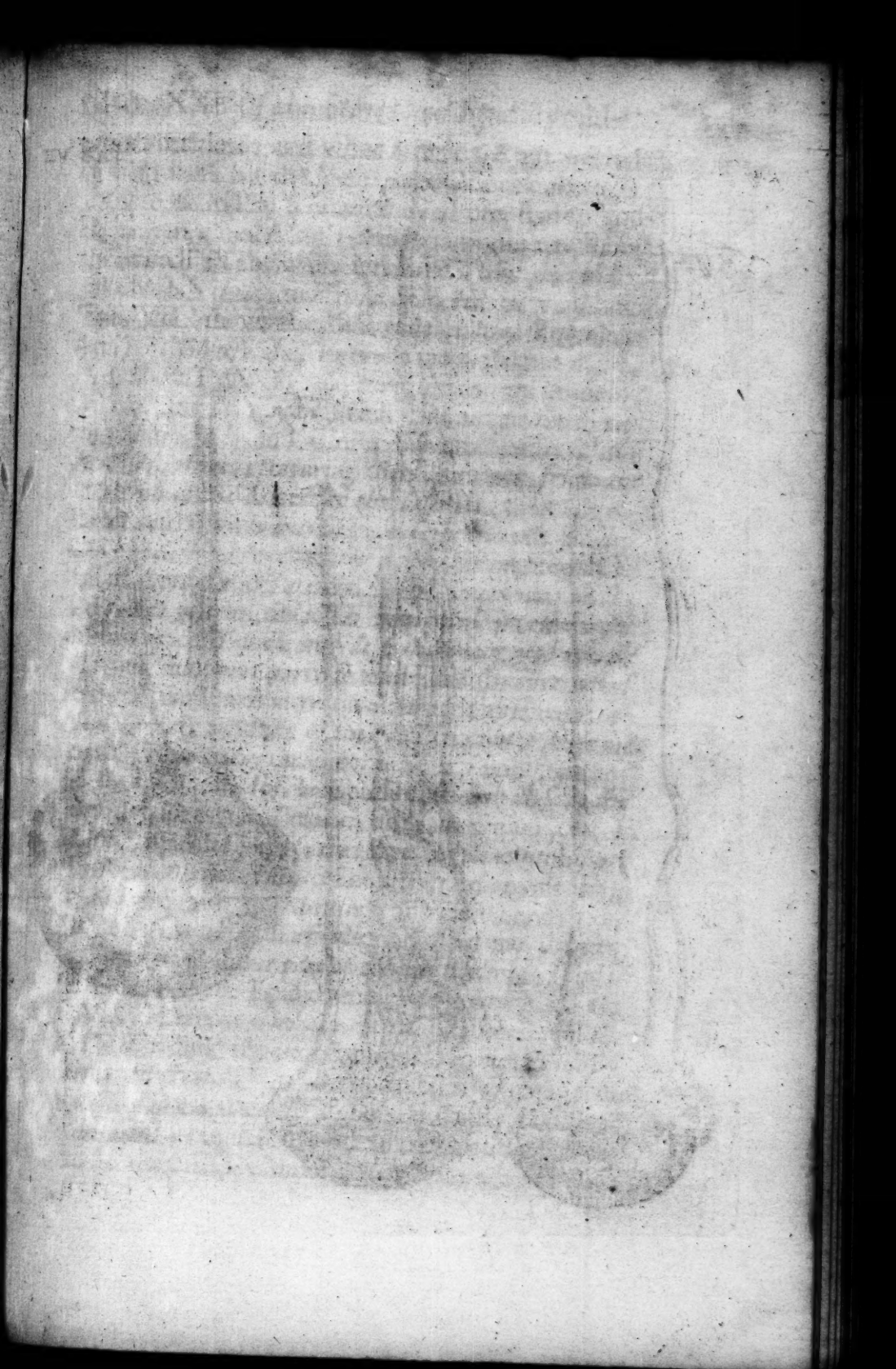


Fig. 1.

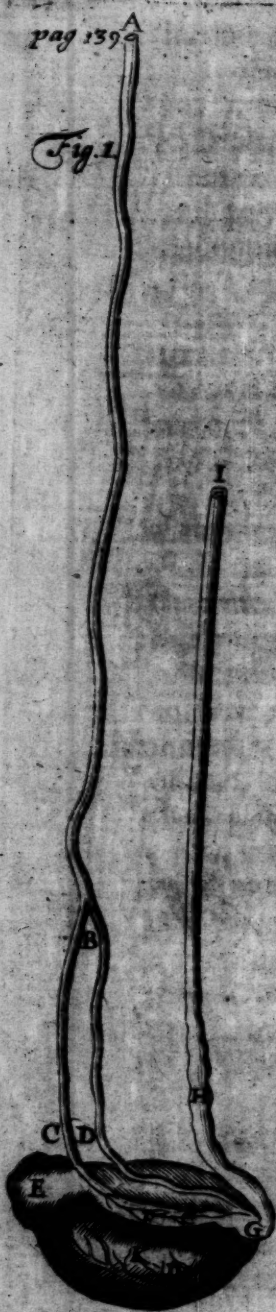
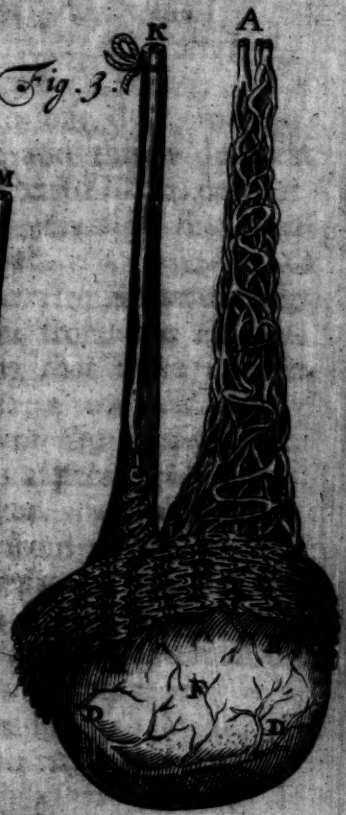


Fig. 2.



Fig. 3.



own nutrition; and what remains from both is carried back by the Veins called *Præparantes*.

The second is, to add heat, strength and courage to the Body, as gelding doth manifest, by the which all these are impaired.

Tab. VII. shews the *Kasa præparantia*, Testes, Epididymidæ, *Kasa deferentia*, &c.

Figure I.

A. The Artery preparing Seed, running from the Trunk of the Aorta to the Testicle.

B. Its division into two branches.

CC. The lesser branch thereof, which runs to the Epididymidæ.

DD. The greater, which is implanted into the upper part of the Testicle and descends along its back towards its lower part, to which the smaller end of the Epididymis is annexed; then it goes back again along the Belly of the Testicle, where it is divided into many branches.

E. The greater end of the Epididymis knit close to the upper part of the Testicle.

F. The middle part of the Epididymis turn'd up, that the ramifications of the Artery that run along its lower part, may be seen.

G. The smaller end of the Epididymis sticking firmly to the lower part of the Testicle.

H. The end of the Epididymis, or beginning of the Vas deferens.

I. The Vas deferens cut off, before it come to behind the Bladder.

K. The Testicle placed so, as that its Vessels may best be seen.

Fig. II.

own nutrition; and what remains from both is carried back by the **Figure M.**

The second is to add heat, strength and con-

A The Vein said to prepare Seed, running from the Trunk of the Vena cava to the Testicle;

BB The branches of the Vena præparans tending to the Caul and Peritonæum.

C The first division of it into two branches, which afterwards are wonderfully subdivided and united again.

DDDD The Valves of the Venæ præparantes, about which the Veins being blown up appear knotty.

EEEE Very many divisions and unions of the Venæ præparantes, that the Bloud superfluous from the generation of Seed, being detained in one ramification, may return to the Heart by the other.

F The upper part of the Testicle into which the ramifications of the Vena præparans are implanted.

G The ramifications of the Venæ præparantes creeping along the sides of the Testicles through their White Coat.

H The Body of the Testicle.

I The bigger end, **K** the middle, and **L** the smaller end of the Epididymis.

M The Vas deferens cut off almost in the middle.

Figure III.

A The Preparing vessels cut off.

B The Preparing vessels as they run to the Testicles.

C Their ramifications tending to the Epididymidæ.

D The greatest branch of the Arteria præparans running along the Belly of the Testicle.

EE The ramifications of the Venæ præparantes.

F A Dog's Testicle swelled with Seed.

G The

Chap. XXII. Of the Vas defer. Vesicul. sem. &c. 141

G The bigger end of the Epididymis is surgid with

Seed.

H The lesser end likewise surgid with Seed.

I The end of the Epididymis or the beginning of the

Vas deferens.

K The Vas deferens of a Dog tied before the Coitus

the Preparing vessels being unbound, that the Sem-

inary vessels being filled with Seed may be seen

more apparently.

~~into the Epididymis, but not terminating in it, but~~

~~coming out of the Epididymis, and growing smaller and~~

~~twisting the Epididymis.~~

CHAP. XXII.

Of the Vasa deferentia, Vesiculæ seminales,

and Prostatae.

~~of the Epididymis, or something like it, and~~

~~of the Epididymis, or something like it, and~~

~~of the Epididymis, or something like it, and~~

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~~of the Epididymis, or something like it, and~~

OUT of the Epididymide at their smaller end arise the two Vasa deferentia, or Ejaculatoria, being but a continuation of them.

They are white, hardish bodies, like a pretty large Nerve, with a Cavity not very discernible, but which may be made so, if one open one of

them six or seven fingers breadth above the Testis,

and then either blow into it with a small

pipe, or squirt some colour'd liquor into it with a

Syringe towards the Testis, for then the Vessel

will be distended, and the colour will run along

its Cavity towards the Epididymide: Or if you

either blow, or squirt liquor by a Syringe the o-

ther way towards the Vesiculæ seminales, the

said Vesiculæ will be distended.

Now from the Epididymide these Vasa deferentia

ascend, and pass out of the Cod into the Abdo-

men the same way by which the Vasa preparantia,

came down, viz. by the process of the Peritonea-

When they are entered the Abdomen, they are carried presently over the Ureters, and turning back again they pass to the backside of the Bladder; between which and the *Intestinum rectum* they march at a little distance the one from the other till about the neck of the Bladder, where they grow wider and thicker; and then just as they are going to meet, their sides open into the *Vesiculæ seminales*, in which they deposit the Seed; but not terminating here, but coming close together and growing smaller and smaller, they go on and end at the *Urethra* betwixt the *Prostata*.

*Vesiculæ
seminales.*

These *Vesiculæ* are little Cells like those in a Pomegranate, or something like a bunch of Grapes; *de Graef* compares them to the Guts of a little Bird diversly contorted. They consist of one thin membrane, through which some small twigs of both Veins, Arteries and Nerves run. They are about three fingers breadth long, and one broad; but in some places broader and some narrower, as they run in and out. They are two, (one for each *Vas deferens*) divided from one another by a little interstice; and they do severally by a peculiar passage emit the Seed contained in them into the *Urethra*. They are very anfractuons and winding, and (as was said) consist of many little Cells, that they should not pour out all the Seed contained in them, in one act of Copulation, but might retain it for several. They have no communication one with another, nor even in their very opening into the *Urethra*; but the Seed that is brought to the *Vesiculæ seminales* on the right side by the right *Vas deferens*, issues by its proper passage into the *Urethra*; and that which

which is brought to the left, likewise. So that if by any accident the *Vesiculae* on one side be burst or cut (as in cutting for the Stone they generally are) yet those on the other being intire may still suffice for generation. Now when the Seed is emitted out of these *Vesiculae* in the act of generation, it passes out the same way it came in; which in this case may easily be, (though otherwise it be unusual there should be a contrary motion in the same Vessel) for as it comes in from the *Vasa deferentia*, it drills along gently without any force; but in *Coitu* when the Muscles of the Yard and all the bordering parts are much tumified, it is expressed or squirted out of them with some violence, and passing along their neck, (which is a continuation of the *Vasa deferentia*), ouzes through a Caruncle (like Quick-silver through Leather) into the *Urethra*, or the Duct of the Yard that is common both to Seed and urine. I say it ouzes from the necks of the *Vesiculae* through a Caruncle into the *Urethra*, for there is one plac'd as a Valve before the orifice of each of them; partly to hinder the coming of the urine into them, partly to hinder the involuntary effusion of the Seed.

Now though naturally the little holes through which the Seed passes out of the necks of the *Vesiculae* into the *Urethra* be almost imperceptible; yet if they be either eroded by the acrimony of the Seed (such acrimony as is contracted by impure embraces, or in Claps as we call them) or if of themselves they be debilitated and so become more lax (as sometimes happens to old or impotent Men that meddle too much) then there happens a *Gonorrhœa* or continual efflux of Seed. And so *Vesalius* and *Spigelius* have observed them
much

much dilated, in dissecting such as have died with a *Gonorrhoea* upon them.

Prostata

The *Prostata* (in English *standers by* or *waiters*) are placed near to the *Vesiculae seminales*; *de Graef* calls them *Corpus glandosum*, supposing them to be one body, and onely divided by the common Ducts of the *Vesiculae seminales* and *Vasa deferentia* coming through the midst of it. They are of a white, spongy and glandulous substance, about as big as a small Walnut, encompass'd with a strong and fibrous Membrane from the Bladder, to the beginning of whose neck they are joyned at the root of the Yard. In shape they come nearest to an oval, save that on their upper and lower part they are a little deprest, and in that end by which the *Vasa deferentia* enter, they are something hollow like a Tunnell. The Sphincter muscle of the Bladder encompasses them, so that for so far as they cover the neck of the Bladder, the Sphincter touches it not, they coming between. They have all sorts of Vessels, which run mostly on their outer side. In their inner part they have ten or more small Ducts which all unload themselves into the *Urethra* by the sides of the great Caruncle (through which the Seed passes from the *Vesiculae* into the *Urethra*) but themselves have each one a small one to stop its orifice, lest the liquor that is contained in the *Prostatae* should continually flow out, or the Urine should flow in. And these small Ducts I suppose are continued from those *Vesiculae* which appear in the *Prostatae* of those that die (any way) suddenly after having had to doe with a Female. For in such, the spongy part of the *Prostatae* is very rurgid with a serous liquor, and in their inner part

part may be found these same *Vesiculæ*, like to *Hydatides*, which if you press upon, they will discharge themselves into the abovesaid Ducts.

What the liquor they contain should be, or *Their use*. what is their use, there is great variety of opinions. Some think that the Seed that flows from the Testicles is further elaborated here. But that cannot be; for that the *Vasa deferentia* deposite nothing in them, but all into the *Vesiculæ seminales*. Others think that from the Blood there is separated in them an acrimonious and serous humour, which serves for titillation or causing the greater pleasure in Venery. As to this, *de Graef* appeals to the taste of it, which has nothing of acrimony. *Dr. Wharton* thinks they make a particular kind of Seed, as the Testicles do another, and the *Vesiculæ seminales* a third. That these last make a Seed different from that made in the Testicles is grounded on a mistake in Anatomy, *viz.* that the *Vasa deferentia* have no communication with the *Vesiculæ*, whereas they apparently open into them, and deposite in them all the Seed they contain. That the *Prostatæ* make a peculiar sort, he endeavours to prove, because gelded Animals emit some Seed. But that is but precarious; for though they emit something, 'tis not necessary it should be any true Seed. Or if it be, it may well be supposed to proceed from the *Vesiculæ seminales* that have been full when the Animal was gelt. For, for this reason it has been observed that presently after gelding they have sometimes got the Female with young, but not afterwards when that stock was spent. *Bartholin* with many others thinks they make an oily, slippery and fat humour, which is pressed out, as there is need, to besmear the *Urethra*, whereby

to defend it from the acrimony of the Seed and Urine, and lest it should dry up. *Diemerbroeck* confesses that it is necessary the inside of the *Urethra* should be kept moist and slippery, but thinks that that is done here as in the Bladder, Intestins and many other places, namely from some mucid part of the nourishment of the *Urethra* it self; and concludes that the *Vasa deferentia* deposite not all the Seed into the *Vesiculæ seminales*, but carry a smaller part to these *Prostatæ*. *De Graef* denies that the *Vasa deferentia* convey any thing to them or have any communication with them; and therefore believes; that the humour that is separated in the *Corpus glandosum* (as he calls the *Prostatæ*) serves for a *Menstruum* or Vehicle of the Seed, which flowing but in small quantity through small pores into the *Urethra*, it was necessary that this humour should be mixt with it that it might better reach the Womb. Whatever this humour be, it is squeezed out partly by the intumescence and erection of the *Penis*, and partly by the compression of the Sphincter of the Bladder that girds the *Prostatæ* about.

These *Prostatæ* are often (at least partly) the seat of the *Gonorrhæa*; and the humour that they contain, that which is shed: for, if it were true Seed, men could never endure a *Gonorrhæa* so long (some, thirty years) without more notable weakening and emaciating, the flux being so large as sometimes it is.

I shall here omit all philosophical enquiries into the nature of the Seed, contenting my self purely with the Anatomical part. How far it contributes to the generation or formation of the *fetus*, shall be shown afterwards, chap. 30. of a *Conception*.

The

The distance betwixt the root of the Cod and Perinæ-
 the Podex is called *Perinæum*, à *perisæa*, *circumfluo*, ^{um.}
 because it is generally moist with sweat. By the ^{Why these}
 Latins it is named *Interfeminæum*, because it is ^{parts in}
 placed *inter femora*, between the Thighs. In ^{men are}
 ripe or grown persons this part, the *Pubes*, *Scro-*
ton and the circuit of the Podex are clad with
 hair, which serves as a veil to cover these obscene
 parts.

C H A P. XXIII.

Of the Tard.

TH E Seed being elaborated and treasured ^{The Tard.}
 up in the aforesaid Organs, there was need
 of a peculiar Instrument whereby it might be con-
 veyed into the Womb of the Female; and to this
 purpose Nature has furnished the Male with a
 Tard, which we come now to anatomize.

It is called in Latin *Penis*, à *pendendo*, because ^{Its name,}
 it hangeth without the Belly. Also *Virga*, *Mem-*
brum virile, *Veretram*, *Mentula*, and by many o-
 ther names invented by lustfull persons and lasciv-
 ious Poets.

It is an Organical part, long and round, yet ^{Descripti-}
 somewhat flat on the upper side, seated under the ^{on.}
Ossa pubis; appointed partly for making of water,
 but principally for conveying the Seed into the
 Matrix.

As to its thickness or length, it differs much in ^{Magni-}
 divers Men. But it is generally observed to be ^{tude.}
 larger in short Men, and such as are not much

given to Venery ; also in those that have high and long Noses, and that are stupid and half witted.

Substance. It is neither bony, as in a Dog, Fox, Wolf ; nor grisly nor fleshy ; but is framed of a peculiar substance, such as might most conveniently admit of distention and relaxation.

Parts. The *parts* of it are either *common* or *proper*.

The *common* are three, the Cuticle, the Skin, and the *Membrana carnosæ*, which we shall not need to describe.

Why it hath no fat.

It hath no *fat*, for first that would have hindered its erection into that stiffness that is necessary ; and secondly would have occasion'd it to grow too bulky ; and lastly would have dull'd that great pleasure that in Venery the Male is affected with in this part.

The *proper* or internal parts are these : the two Nervous bodies, the *Septum*, the *Urethra*, the *Glans*, four Muscles and the Vessels.

The nervous bodies.

The *Nervous bodies* (so called) are encompassed with a thick, white, nervous and very firm Membrane, (like an Artery) but their inner substance is spongy, being mostly a contexture of Veins, Arteries and Nervous fibres; woven one with another like a Net ; and when the Nerves are filled with Animal spirit, and the Arteries with hot and spirituous blood, then the *Penis* is distended and becomes erect : but when the Spirits cease to flow in, then the Blood and remaining Spirits are absorbed by the Veins, and so the *Penis* becomes limber and flaggy.

They spring from the lower side of the *Ossa pubis* at distinct originals, where they appear like two horns, or are of a figure resembling the Letter Y, that the *Urethra* may have room to pass between them. When they leave the *Ossa pubis* they

they are each covered with a several Membrane, and are afterwards joined together with onely the *Septum* between, which the nearer it comes towards the *Glans*, is the thinner, so that before it come to the middle of the *Penis* its Fibres extend towards the back of the Yard from the *Urethra* in order like a Weaver's Slay, and while it still goes further, its Fibres by degrees grow so very small, that near the *Glans* the *Septum* is almost obliterated, and the two Nervous bodies grow into one. Whence it is that the *Penis* is equally erected; for if the *Septum* had exactly distinguish'd one part from the other, it might sometimes have so happened by the compression or obstruction of the Arteries of the one or the other side, that one part of it would have been extended, and the other remained flabby.

Dr. *Wharton* affirms, these Nervous bodies have Glandulous flesh within them, which keeps the Yard something plump even when it is not erect. But *de Graef* denies this, and demonstrates, that they have no other substance than before said, thus. Let the Yard be prepared thus: First gently squeeze the blood out of it, which it always has in greater or lesser plenty, and then put a little Tube into the spongy substance, namely in at that end that is next to the *Os pubis*; and let the Cavity of the *Penis* be half fill'd with water by the help of a Syringe, and shake the *Penis* with the water in it: pour out that bloody water, and fill it again with clear, and so three or four times till the water is no longer stain'd with blood. Then betwixt two Linen cloths squeeze out what water is in the Nervous bodies, and at length blow up the *Penis* so long till it have its natural bigness; in which posture if you will keep it, you must tie it hard.

When the *Penis* is thus distended and dried, you may examin it as you please, and will find no other substance than was mentioned. *Diemerbroeck* says that their substance is not a mere texture of Vessels, but is fibrous, fungous and cavernous (such as is the substance of the Lungs) receiving in their hollow Interstices Bloud and Spirits out of the Vessels that are dispersed through their substance.

The Ure-
thra.

Below these Nervous bodies lies the *Urethra*, being of a much like substance to them, saving that its spongy part, which is outer and lower, hath less pores because of its smaller and more plentiful Fibres. This part does tumefy whenever the Nervous bodies do. Its inner part is membranous, round and hollow, and exceeding sensible. It is of an equal largeness from one end to the other, save in its fore-part, where the *Glans* is joined to the Nervous bodies, for there it hath a small Cavern, into which the acrimonious Urine lighting in the Stone of the Bladder, while it wheels about in it, causeth pain, and is a great sign of the Stone. Sometimes also the acrimonious eroding liquor in a *Gonorrhœa* staying here, doth cause a most tormenting ulceration.

It is continuous to the neck of the Bladder, but has not its rise from it, nor is of the same kind of substance. If you boil the Bladder and it, it will easily separate, and appears of a clear other substance and colour. It begins at the neck of the Bladder and reaches to the end of the *Glans*, which it seems to bestow a Membrane upon from its own inner one, for it is plainly continued from it.

Its use.

Its use is to convey along the Seed, and Urine.

And

And to that end there open into it small pores that transmit the Seed into it from the necks of the *Vesiculæ seminales* (of which in the foregoing Chapter ;) and also the neck of the *Vesica Urinaria* which pours out the Urine into it , at which place it has a membranous Valve, of which likewise before in Chap. 19.

The *Muscles* are two in each side, and so four *Muscles* in all. Of these one pair are called by some Collateral muscles, by others *Erectores*. These are shorter and thicker, and spring from the appendix or knob of the *Coxendix*, under the beginning of the Nervous bodies, and are inserted into the same, a little from their beginning. These serve for erection of the *Penis*.

The second pair is longer and smaller, proceeding from the sphincter of the *Anus*. These pass straight by the sides of the *Urethra*, and are inserted into it about its middle ; they serve to dilate it for miction and ejaculation of the Seed, and are called *Dilatantes*, wideners, and *Acceleratores*, hastners.

These have been generally held to be the uses of these Muscles, but *de Graef* (as also *Swammerdam*, *not. in prodr. p. 35.*) assigns a clear contrary use to them, and that with great shew of reason. For seeing the action of a Muscle is contraction, how should the former pair extend the *Penis*, and not rather draw it back towards their original? Or how should the latter serve to dilate the *Urethra*, and not rather straiten it, seeing in the action or contraction of a Muscle its Belly or Middle swells? Therefore he says that the Muscles onely contribute thus far or in this respect to the extension or erection of the *Penis*, in as much as by their swelling (partly by bloud and spirit flowing

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ing into them, partly by their proper action) they serve to straiten and compress the roots of the Nervous bodies and the spongy part of the *Urethra*, and so drive the Bloud that flows in by the Arteries towards the *Glans*, and hinder its returning back again by the Veins: a resemblance whereof may be exhibited by a piece of a Gut, which if we fill with wind or water, and then compress that end by which they enter'd (the other being ty'd) we shall see the other strut out and be more distended.

Glans.

The end or head of the *Penis* is called *Glans*, and *Balanus*. Into this the Nervous bodies terminate; and being a little thicker (on that side next them) than they, it forms a kind of a circle. On its fore-part it is smaller and sharper. It has a peculiar substance (Dr. *Wharton* says glandulous) soft and spongy, and being covered with a very thin Membrane produced from the internal one of the *Urethra* (which coming out of its hollow, dilates itself so as to cover all the *Glans*) it thereby, and from its proper substance much interwoven with Nerves, becomes most exquisitely sensible, and is the principal seat of pleasure in copulation. Which if it had not been very great, who would have taken delight in so brutish a thing as Venery? as *Andreas Laurentius* elegantly expostulates, (*Anat. lib. 7. cap. 1. q. 7.*)
 “Who (most strange!) would have solicited or
 “accepted of so vile and filthy a thing as lying
 “with a Woman? with what face would Man,
 “that divine Animal, full of reason and counsel,
 “have handled the obscene parts of Women polluted with so much filth, which is discharged
 “into this low place as into the common sink of
 “the Body? On the other side, what Woman
 “would have accepted of the embraces of a Man,
 “considering

“ considering the toil and tediousness of going nine
 “ months with Child, the most painfull and often
 “ fatal bearing of it, and its education full of care
 “ and anxiety, unless the Genitals had been af-
 “ fected in the act of coition with transporting
 “ pleasure ?

The *Glans* is covered with the *Præputium*, or Præputi-
 Fore-skin, which is framed of the reduplication um.
 of the Skin.

It is called *Præputium*, because it is placed *præ*
pudendo before the Yard : or rather *à præputando*,
 from being cut off, for this is that which the Jews
 cut off in Circumcision, from whence they are
 called *Apellæ* and *Recutiti*. And it is reported by
 divers persons from their own inspection, that in
 Jewish Children it is six times as large as in Chri-
 stians, and hangs a great way over the *Glans*, be-
 fore it be cut off.

The Ligament by which the Prepuce is tied *Frænum*.
 to the *Glans* in the lower part of it, is called
Frænum, the Bridle.

Of the *Vessels*, some are *cutaneous*, some pass to *The Ves-*
 the inner parts of the *Penis*. *sels.*

The *cutaneous Veins* and *Arteries* spring from *Veins and*
 the *Pudendæ* ; these entring at the root of the *Arteries.*
 Yard, pass by the sides towards the back of it,
 and are conspicuous enough. The Vessels which
 are bestowed upon the inner parts of it, come from
 the *Venæ* and *Arteriæ hypogastricæ*, and enter just
 at the meeting of the two Nervous bodies, through
 whose length they run, and are mostly disperied
 in them, and in the fungous part of the *Urethra*,
 sending forth little twigs at the sides.

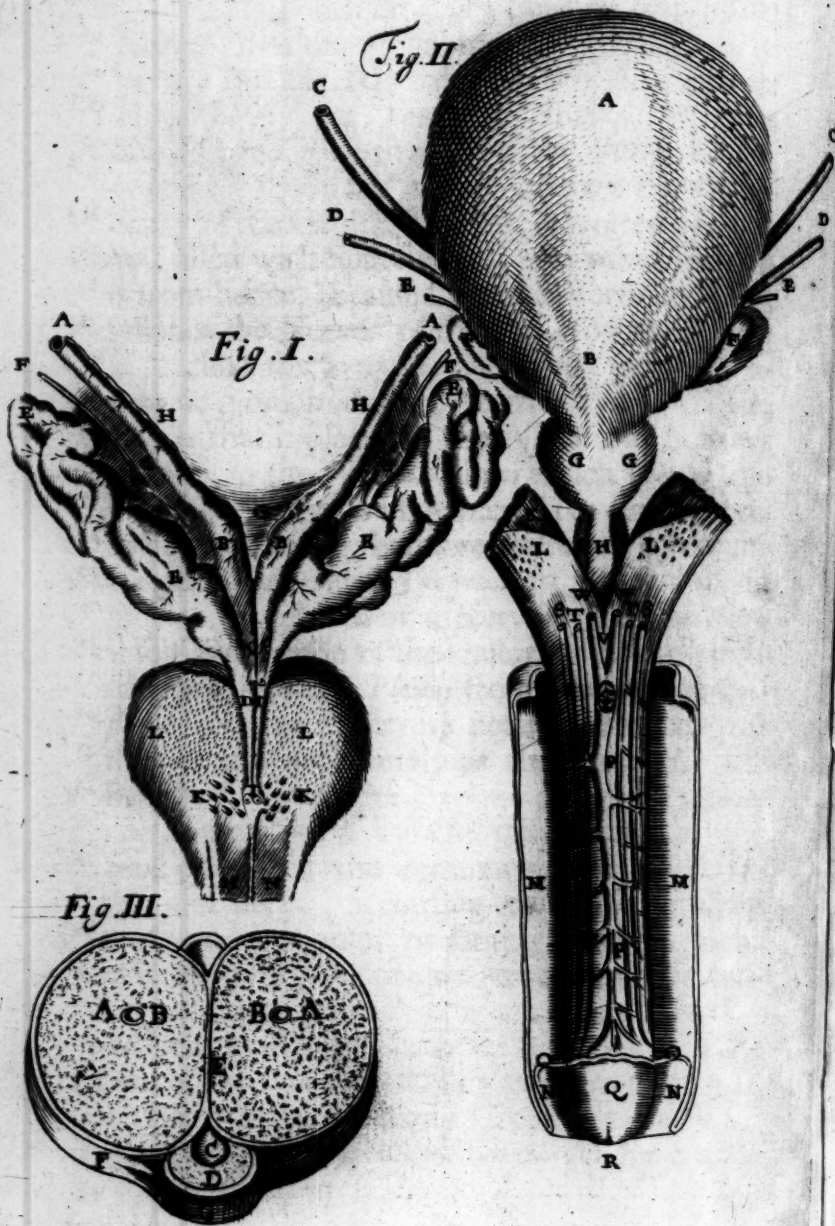
It has two *Nerves* from the lowest Vertebral *Nerves*.
 The greater of them, that is very large and long,
 is distributed into the Nervous bodies, *Urethra*
 and

and *Glans*; the lesser is bestowed upon its Muscles. Concerning which Dr. *Willis* thus discourses. "This Member (says he) having onely
 "Nerves from the Spinal marrow, should onely
 "have a spontaneous motion according to our
 "Hypothesis (*viz.* that the Nerves from the
 "Brain serve for natural, and the Vertebral for
 "voluntary motion.) And yet through the turgescency of the Genital humour, it is often erected
 "and filled with Spirit against ones mind; which
 "is from hence, because from this Vertebral pair,
 "whence the Nerves of the *Penis* spring, a sprig
 "is reached forth to the Vertebral pair next above it, *viz.* to that in which is radicated the
 "Plexus that is placed in the *Pelvis* and bestows
 "Nerves on the *Prostata*, into which Plexus also
 "a notable Nerve is implanted from the Intercostal pair. Seeing therefore there is a communication between the *Prostata*, (which depend
 "much on the Intercostal Nerves) and the *Penis*
 "it self (by reason of the insertion of the
 "said sprig into the Plexus from whence the *Prostata*
 "have their Nerves) hence it comes to pass
 "that it acts accordingly as they are affected.
 "But they, (*viz.* the *Prostates*) are not onely
 "apt to be moved by the turgescency of the
 "Seed; but, by the communication of the Intercostal nerve, according to the impressions
 "made on the Senses or Brain, are wont to be
 "irritated by too importune an action; into consent wherewith the *Penis* is presently excited.

Use.

Its principal use is to convey the Seed into the *Uterus* of the Female; and its use to piss withall, is but secondary, for many Creatures (as Fowls in general) make no water by it, yet have a *Penis* for the use abovesaid.

That



That part that is next above it towards the Belly, is called the *Pubes*; and its lateral parts are called *Inguina*, the Groins.

Tab. VIII.

Fig. 1. shews the *Vasa deferentia*, Seed-bladders, and Prostates.

AA Parts of the *Vasa deferentia*, which appear thick, but have onely a small Cavity.

BB The parts of the *Vasa deferentia* of a thin substance and large Cavity, being widened.

CC The extremities of the *Vasa deferentia* narrowed again, and gaping each with a little hole into the neck of the Seed-bladders.

DD The neck of the Seed-bladders parted from each other by a Membrane going between, so that the Seed of one side cannot be mixed with that of the other, before it come to the Urethra.

EE The *Vesiculæ seminales* or Seed-bladders blown up, that their wonderfull widenings and narrowings may be seen.

FF Vessels tending to the Seed-bladders.

CGG The Membranes whereby the Seed-bladders and *Vasa deferentia* are kept in their places.

HH The Sanguinary vessels running by the sides of the *Vasa deferentia*.

I A Caruncle resembling a Snipe's head, through whose eyes as it were the Seed issues out into the Urethra.

KK The Ducts of the *Corpus glandosum* or Prostate opening into the Urethra by the sides of the Caruncle.

LL The *Corpus glandosum* divided.

MM The Urethra opened.

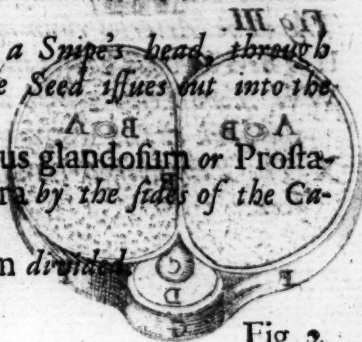


Fig. 2.

Fig. 2. shews the Bladder, &c. the Penis and its Vessels, &c.

- A *The upper or fore-part of the Bladder.*
- B *The neck of the Bladder.*
- CC *Portions of the Ureters.*
- DD *Portions of the Vasa deferentia.*
- EE *The Vessels running to the Seed-bladders.*
- FF *The Vesiculæ seminales or Seed-bladders.*
- GG *The fore-part of the Prostatae or Corpus glandosum.*
- H *The Urethra adjoining to its spongy part.*
- KK *The Muscles called the Erectors or Extenders of the Penis.*
- LL *The beginnings of the Nervous bodies separated from the Ossa pubis, which puff up like Bellows when the Yard is erected.*
- MM *The Skin of the Penis drawn aside.*
- NN *The duplicature of the Skin making the Præputium.*
- OO *The Skin that was fasten'd behind the Glans.*
- PP *The back of the Penis.*
- Q *The Glans.*
- R *The urinary passage whereby the Glans is perforated in its fore-part.*
- SS *The Nerves running along the back of the Penis.*
- TT *The Arteries running along the back of the Penis.*
- U *The Nervous bodies meeting together.*
- WW *Two Veins which unite together, and run along the back of the Penis in a remarkable branch.*
- X *The Vein opened, that the valves in it may be seen.*

Fig. 3.

Fig. 3. shews the Penis cut asunder transversely.

AA The spongy or fibrous substance of the Nervous bodies.

bb The two Arteries that march along the Nervous bodies.

C The urinary passage of the Urethra.

D The spongy substance of the Urethra.

E The Septum between the two Nervous bodies.

FF A very strong Membrane of the Nervous bodies.

G A very thin Membrane containing the spongy substance of the Urethra.

H A notable Vein creeping along the back of the Penis.

Of the GENITALS in Women.

CHAP. XXIV.

Of the Vasa præparantia.

HAVING now done with the Parts ministring to Generation in Men, we next proceed to those of Women; in describing of which it has been the method of divers Anatomists to begin first with the outer parts of the Privy: but because we would observe, as much as may be, the same order in Women as we have in Men, we shall first begin with the Spermatick vessels, which are of two sorts, Arteries and Veins.

The Arteries are two, as in Men. They spring from the great Artery a little below the Emul-
gents
Sperma-
rick ar-
ries.

gents (very rarely either of them from the Emulgent it self) and pass down towards the *Testes* not by such a direct course as in Men, but with much twirling and winding amongst the Veins, with which tho' they have no inosculation, as has been generally taught. But for all their winding, when they are stretcht out to their full length, they are not so long as those of Men; because in them they descend out of the *Abdomen* into the *Scrotum*, but in Women they have a far shorter passage, reaching onely to the *Testes* and Womb within the *Abdomen*.

Veins.

The *Veins* are also two, arising, as in Men, the right from the trunk of the *Carva* a little below the Emulgent, the left from the Emulgent it self. In their descent they have no more windings than in Men, and therefore are considerably shorter.

Both the *Arteries* and *Veins* as they pass down are cover'd with one common Coat from the *Péritonæum*; and near the *Testes* they are divided into two branches, the upper whereof is implanted into the Testicle by a triple root; and the other is subdivided below the *Testes*, into three twigs, one of which goes to the Bottom of the Womb, another to the *Tuba* and round Ligament, the third creeping by the sides of the Womb under its common Membrane, ends in its neck, where it is interwoven with the Hypogastrick vessels like a Net. By this way it is that the *Menses* sometimes flow in Women with Child for the first months, and not out of the inner Cavity of the *Uterus*: but yet that Blood does not flow at that time so much by the Spermatick Arteries as by the Hypogastrick.

Their use.

The use of these Spermatick vessels is to minister to the (generation of Seed, according to the ancient

ancient doctrine ; but) nutrition of the Eggs in the *Ovaria* or *Testes* (according to the new) the nourishment of the *Fetus*, and of the Womb it self, and the expurgation of the *Menses* ; inasmuch as Blood is conveyed by the Arteries to all those parts to which their ramifications come, in which parts they leave what is to be separated according to the law of Nature, the remaining blood returning by the Veins.

CHAP. XXV.

Of *Womens Testicles* or *Ovaria*.

WOMENS *Testicles* differ much from Mens *Testes* both in their situation, figure, greatness, coverings, substance, and also use.

First, their situation is not without the Body, as in Men, but in the inner Cavity of the *Abdomen*, on each side two fingers breadth distance from the bottom of the Womb, to whose sides however they are knit by the intervention of a strong Ligament, that has us'd to be called and accounted the *Vas deferens* ; as if the Seed were carried by it from the *Testes* to the Womb. Of which afterwards.

They are flat on the sides ; in their lower part oval, but in their upper (where the Blood-vessels enter them) more plane. Their superficies is more rugged and unequal than in those of Men. They have no *Epididymides*, nor *Cremaster Muscles*.

They

Greatness. They differ in *bigness* according to age. In those newly come to maturity they are about half as big as those of Men; but in those in years they are less and harder. Preternaturally they sometimes grow to a vast bigness from Hydropical tumours, in which several quarts of serous liquor have been found to be contain'd.

Tunicle. They have but one *Membrane* that encompasses them round; but on their upper side, where the *Vasa præparantia* enter them, they are about half way involved in another Membrane that accompanies these Vessels, and springs from the *Peritoneum*.

Substance. When this cover is removed, their *substance* appears whitish, but is wholly different from the substance of Mens Testicles. For Mens (as was said above) are composed of Seminary vessels, which being continued to one another are twenty or thirty Ells long if one could draw them out at length without breaking: But Womens do principally consist of a great many Membranes and small Fibres loosely united to one another; amongst which (in the outer superficies of the *Testes*) there are several little Bladders (like to *Hydatides*) full of a clear liquor, through whose Membranes the Nerves and *Vasa præparantia* run, and are obliterated in them.

Whether they elaborate seed.

The liquor contained in these Bladders had always been supposed by the followers of *Hippocrates* and *Galen* to be Seed stored up in them, as if they supplied the place of the *Vesiculæ feminales* in Men. But from Dr. *Harvey* downwards many learned Physicians and Anatomists (according to *Aristotle*) have denied all Seed to Women. Of which the said Dr. *Harvey* thus discourses, *De ovi materia, Exercit. 34.* "Some Women emit

"emit no such humour as is called Seed, and
 "yet is not conception thereby necessarily fru-
 "strated; for I have known several Women (says
 "he) that have been fruitfull enough without
 "such emission; yea, some that after they be-
 "gun to emit such humour, though indeed they
 "took greater pleasure in copulation, yet grew
 "less fruitfull than before. There are also in-
 "finite instances of Women, who though they
 "have pleasure in coitu, yet send forth nothing,
 "and notwithstanding conceive. *Miror maxime,*
adds he, eos, qui emissionem hanc ad generationem
necessariam putant, non animadvertisse, humorem il-
lum foras ejici, & circa clitoridem vulvaeque orifici-
um ut plurimum profundi, raro intra vulvum, nun-
quam vero intra uterum, ut cum maris spermate mis-
ceatur; esseque consistentia serosum sive chorosum,
ad modum urinae; non autem geniturae instar, len-
tum atque unctuosum; ut tactu facile innotescit.
Quorsum autem foras ejiciatur, cujus usus necessariò
intus requiritur? Debuitne humor ille, ceu utero va-
ledicturus, ad limen vulvae amandari; ut majore
cum gratia ab utero retraheretur denuo?] So that
 both from the place of its emission, and from its
 consistence, he concludes that the humour emit-
 ted cannot be Seed. To strengthen which opi-
 nion two reasons may be added, why it cannot
 be the humour contained in these *Vesiculae*, and
 consequently that it cannot be Seed; first be-
 cause it is sent forth in greater quantity than that
 it can be supplied from them; and secondly be-
 cause the *Vesiculae* are destitute of any such pore
 or passage whereby the liquor contained in them
 might issue out; for if you press them never so
 hard, unless you burst them, there will nothing
 pass out of them.

They are
Ovaries.

We must therefore subscribe to that new but necessary opinion that supposes these little Bladders to contain nothing of Seed, but that they are truly Eggs, analogous to those of Fowl and other Creatures; and that the Testicles (so called) are not truly so, nor have any such office as those of Men, but are indeed an *Ovarium* wherein these Eggs are nourished by the Sanguinary Vessels dispersed through them, and from whence one or more (as they are fecundated by the Man's Seed) separate, and are conveyed into the Womb by the *Tuba Fallopiana*, of which by and by.

That these *Vesiculae* are analogous to the little Eggs in the *Ovarium* of Fowl, *de Graef* evinces by this Experiment, That if you boil them, their liquor will have the same colour, taste and consistency with the white of Birds Eggs. And their difference in wanting shells is of no moment; for even the Eggs of Fowls while they are in the Ovary (yea after they have descended into the *Uterus*) have no shell: and though when they are laid, they have one, yet that is nothing essential to them, but onely a fence that Nature has provided (upon their exclusion) to preserve them from external injuries while they are hatched without the body; whereas these of Women being fostered within their Body, have no need of other fence than the Womb, by which they are sufficiently defended.

Having compared these *Vesiculae* to the Eggs of Fowls, I might here follow the method of Doctor *Harvey* and *de Graef*, and describe the *Ovarium*, &c. in Hens, &c. that from thence these in Women might the better be conceived of and apprehended; but to the curious and learned Reader

der I shall recommend the said Authors for satisfaction, and avoiding all unnecessary and (to this Epitome) unsuitable excursion, I shall onely further note two things: First, that these Eggs in Women are commonly towards the number of twenty in each Testicle or Ovarium, of which some are far less than others. And secondly, that the objection of the Galenists against the Aristotelians, (*viz.* that the Testes of Females must needs make Seed, because when they were cut out, barrenness always follow'd) will be sufficiently obviated by this new Hypothesis, that agrees to the necessity of the Testicles so far as to affirm that the Vesiculæ contained in them become (when they are impregnated by the Masculine Seed) the very Conceptions themselves, which therefore it would be in vain to expect if the Female were castrated.

Besides the Vasa præparantia, and Nerves (of which in the 27th Chapter) they have also Lympheducts, according to Dr. Wharton.

C H A P. XXVI.

Of the Vasa deferentia in Women, or their Oviducts.

Alen with most of the Ancients reckoned those short processes that go straight from the Testes to the bottom of the Womb, to be Vasa deferentia; and that the Seed was emitted from the Testes through them into the Fundus uteri. And Fernelius, Riolanus, &c. thought they found a

small Pipe passing on each side out of these processes by the sides of the Womb to its neck, into which they were inserted and opened near its orifice. By the former it was supposed Women not with Child did emit their Seed into the bottom of the Womb; and by these latter such as were already impregnated: for that, if it should have issued into the *Fundus* where the Conception was, it would there have corrupted to the great prejudice of the *Fœtus*.

But as to these latter ducts, *Veslingius*, *Diemerbraeck*, *de Graef* and many other accurate Anatomists, have not been able to find the least foot-step of them. And as for the former, seeing they are not pervious, nor have any Cavity, (and therefore can neither contain nor convey any thing of Seed) we must conclude with *de Graef* that they are onely Ligaments of the Testicles to keep them in their place; which he evinces further by observing, that they come not to the inner Cavity of the *Uterus*, but are knit onely to its outer Coat: for he says, there are onely two holes in the *Fundus uteri* that admit a Probe, and those lead to the *Tubæ Fallopianæ* and not to these Ligaments.

Tubæ Fal-
lopianæ.

Seeing therefore that those which have been accounted *Vasa deferentia* either are not to be found at all, or are found incapable of such an office; and having withall rejected the opinion of Womens having Seed, and affirmed that that which makes the conception is one of those *Vesiculæ* in the *Testes*, dropping from thence and conveyed into the Womb, we must inquire by what way these can pass. For if the abovesaid Ligaments (reputed *Vasa deferentia*) have no passage whereby even the *Semen*, if there were any might
be

be conducted ; much less could one of these *Vesiculae* be conveyed that way. And therefore for *Vasa deferentia* we assign those ducts that *Fallopius* in his Anatomical observations calls *Tubae*, and describes thus : “ They are very slender and narrow ducts, nervous and white, arising from the horns (or sides) of the Womb, and at a little distance from it they become larger, and twist like the tendrel of a Vine, till near their end, where ceasing their winding they grow very large, and seem membranous, and carnosus from their red colour. Which end is very much torn and jagged like the edge of rent Cloths : and has a large Foramen, which (says he) always lies closed, because those jags fall together ; but yet being opened carefully they are like the utmost orifice of a Brass Trumpet.] But *de Graef* says, though they grow very large towards their end, yet of a sudden the very extreme part is narrowed before it is divided into the aforesaid jags, which he resembles unto leaves. Who also appeals unto experiment for these *Tubae*’s being pervious, affirming that if one put a little Tube into the beginning of one of these same Trumpets and blow it, the wind will presently break through it, which he saith he has observed in all the kinds of Animals that he has dissected.

“ These *Tubae* (according to Dr. *Harvey*) are the same in Women that the *Cornua* or Horns of the Womb are in other Creatures. For they answer to those both in situation, connexion, amplitude, perforation, likeness and also office : for as other Animals always conceive in the *Cornua*, so it has been sometimes observed (as by *Riolanus* from others ; and by Dr. *Harvey* himself) that a conception has in a Woman
“ been

"been contained in one of the *Tubæ*.] Which
 "must have happened, when the *Ovum* being received out of the *Testis* into it, has been stopt in its passage to the Womb, either from its own bigness, or some obstruction in the *Tubæ*.

Their substance.

Their *substance* is not nervous (as *Fallopins* in the above-recited description affirms) but membranous. For they consist of two *Membranes*, the *outer* and *inner*. The *inner* springs from (or at least is common with) the inmost membrane of the Womb; but whereas it is smooth in the Womb, it is very wrinkled in the *Tubæ*. The *outer* is common with the outmost of the Womb; and this is smooth.

Width.

The *capacity* of these ducts varies very much: for in the beginning as it goes out of the Womb, it onely admits a bristle, but in its progress where it is largest it will receive ones little finger. But in the outmost extremity where 'tis divided into jags, it is but about a quarter so wide.

Length.

They are very uncertain also in their *length*; for from four or five, they sometimes encrease to eight or nine fingers breadth long.

Use.

Their *use* is, In a fruitfull copulation to grant a passage to a more subtile part of the Masculine seed (or to a seminal air) towards the *Testes*, to bedew the Eggs contained in them; which Eggs (one or more) being by that means fecundated (or ripened as it were) and dropping off from the *Testis* (in the manner as shall be described Chap. 30.) are received by the extremity of the *Tubæ*, and carried along their inner Cavity to the *Uterus*. For Dr. *Harvey* affirms that they have a worm-like or peristaltick motion like that of the Guts (*de Cervuarum & Damarum Utero, Exercit. 65.*) And the same is affirmed by *Swammerdam*, *Not. in Prodr.*

A

Against this use two objections may be made; *Objections against their use answered.*
 First that the end of the *Tuba* not adhering close to the *Testis*, when one of the *Vesiculæ*, (or *Ova*, as we think they are) shall drop off from the *Testis*, it would more probably fall into the Cavity of the *Abdomen*, than light just pat in the mouth of the *Tuba*. Secondly, That when it is received by it, its duct is so narrow, that 'tis hard to conceive how it can pass by it.

As to the *first*; the same objection may lie against the use of the Oviduct or *Infundibulum* in Hens, for neither in them does it join quite close to the *Ovarium*, (as *Swammerdam*, &c. truly observes) and yet it is certain that the *Vitelli* or little Yelks (or rudiments of the Eggs) do all pass by them to the *Uterus*. The same, *Swammerdam* observes also in Frogs, in one of whom there are many hundreds of Eggs, which all pass one after another from the *Ovarium* by the Oviduct or *Infundibulum*, and yet the mouth of the Oviduct is almost two fingers breadth from the *Ovarium*, and besides is immovable, whereas the *Tubæ* in Women are at liberty (and are more than long enough) to embrace the *Ovarium* with their orifice: and we may reasonably believe that they do so when a conception is made; for it is not improbable that when all the other parts of the Genital are turgid in the act of Copulation, these *Tubæ* also may be in some measure erected, and extend their opened mouth to the *Testicle*, to impregnate the *Ova* with the Seminal air steaming through their duct, and if any one be secundated and separate, to receive it afterwards by its orifice.

As to the *second objection*, which urges the narrowness of these *Tubæ*; He that considers the

straitness of the inner orifice of the Womb, both in Maids and Women with Child, and yet observes it to dilate so much upon occasion as to permit an egress to the Child out of the Womb, cannot wonder that to serve a necessary end of Nature the small duct of the *Tuba* should be so far widen'd as to give passage to an *Ovum*, seeing its proportion to their duct is many times less than of the Child to the usual largeness of the said orifice.

C H A P. XXVII.

Of the Uterus or Womb, and its Neck.

HAVING treated of the *Vasa præparantia* (so called) that bring nourishment to the *Testes* or *Ovaria*, as also of these and their *Ova*, and lastly of the *Tuba* through which the *Ova* pass to the *Uterus*; we now come to the *Uterus* it self which receives the *Ova*, and in which the conception is formed, and the *Fætus* nourished till it acquire its due maturity and be fit for the birth.

The
Womb.

The *Uterus* or Womb is usually divided into four parts, the *Fundus* or bottom, *Os internum* or *Cervix*, the *Vagina*, and the *Sinus pudoris* or outward Privy. Of each of these in order. And first of the *Fundus*.

Its name.

This in a special manner is called the Womb, because all the rest seem to be made for its sake. It is also called the *Matrix*, from its being as a Mother to conserve and nourish the *Fætus*; and likewise *Utriculus* from its shape resembling a *Battle*.

It is seated in the *Hypogastrium* or lowest part
of

of the *Abdomen*, in the middle of that large hollow that is called *Pelvis*, and is formed by the *Ossa ilii*, the Hip, the *Ossa pubis*, and the *Os sacrum*. In this Cavity it is placed between the Bladder and the streight Gut; so that Man being bred betwixt piss and dung, if he would but consider his origine, might hence draw an argument of humility.

Its hindmost part is loose, that it might be extended as the *Fetus* encreaseeth. But its sides are tied fast by two pairs of *Ligaments*.

The first pair are further from the *Os internum*, and are broad, arising from the *Peritonæum*. They have a membranous, loose and soft substance, and for their shape are resembled to Bats wings. They tie the sides of the *Fundus*, the *Testes* and a good part of the *Tubæ* together, and are fasten'd to the *Ossa ilii*, whereby the Womb is kept from falling down upon its Neck. But if they be either immoderately relaxed, or by any violence broken, then the Womb descends and sometimes falls out (turning inside outwards) if the substance of the Womb happen to be relaxed also.

The second pair arise nearer to the inner orifice of the *Vagina*, about where the *Tubæ* do, and are called the round Ligaments, or worm-like. From their origine which is broad, they ascend on each side between the duplicature of the *Peritonæum* towards the Groins, and running out of the Cavity of the *Abdomen* become round, and then pass obliquely above the *Os pubis* towards the fat of *Mons Veneris* in which they terminate near the *Clitoris*, being divided into many parts or jags, as may be seen in the following figure. They consist of a double Membrane, the inner whereof has all sorts of Vessels, Nerves, Arteries, Veins and *Vasa Lymphatica*; and are about a span long.

Vellin-

Veslingius, *Dianterbroeck*, &c. say that they receive a small Seminal vessel from the *Testes* and *Tubæ*, which they conduct to the *Clitoris* into which they are inserted, and ought rather to be accounted *Vasæ deferentia* than Ligaments. So that what some Women emit from about the *Clitoris* in coition they think to be true Semen conducted hither by those seminal ducts. But *de Graef* denies any such ducts, and affirms that these Ligaments reach not the *Clitoris*, but are terminated in the aforesaid fat. And that humour which Women emit (sometimes) he thinks doth issue out of the *Lacuna* in the orifices of the *Vagina* and urinary passage, or also from the *Meatus*'s in the neck of the Womb: Which humour is supplied to the former parts from the thick and membranous body that is about the urinary passage; and to the latter from the nervous-membranous substance of the neck of the Womb: but he thinks it does not partake of the nature of Seed, but serves onely for the lubricating of the *Vagina* to cause the greater pleasure in coitu. But to this purpose more before.

Substance. Its substance is whitish, nervous or rather membranous; dense and compact in Virgins, but in Women with Child a little spongy and soft.

Membranes. It hath two Membranes. The outer which is common, is strong and double, arising from the *Peritonæum*; the inner, being proper, is fibrous and more porous. Betwixt these Membranes there is a certain carnosus and fibrous contexture, which in Women with Child, together with the said Membranes, does imbibe so much of the nutritious humours that then flow thither, that the more the *Fœtus* encreaseth, the more fleshy, fibrous and thick doth the Womb grow; so that in the

the last months it becomes an inch thick, and sometimes two fingers breadth, though it be extended to so much greater compass than it has when a Woman is not with Child. And yet (which is strange) within sixteen or twenty days after a Woman is brought to Bed, it becomes as thin as before (*viz.* about half a fingers breadth) and the whole contracts into so little a compass as to be held in ones hand.

In Virgins it is about two fingers breadth *Bigness.* broad, and three long. In those that have lain with a Man it is a little bigger, and something larger yet in those that have born Children.

In *shape* it is something like a Pear, onely a little flatish above and below. But in Women with Child it becomes more round. *Figure.*

In Maids its *Cavity* is so small that it will hardly hold a large Hazel nut. In those that have had Children it will hold a small Walnut. It is divided into no Cells as it is in most viviparous Brutes, but onely into the right and left side by a Suture or line that goes lengthways, much like that on the outside of the *Scrotum* in Man. Its *Cavity* is not quite round, but jets out a little towards each side; which jetting some call its Horns, but improperly: for though *Galen* (and many after him) having never dissected any Woman, presuming that their Womb was like that of other viviparous Creatures, attributed *Cornua* thereto, yet in truth they have none; but the *Tubæ Fallopianæ* (as was noted before) answer to them in many respects. Onely in Brutes (*viz.* such as have *Cornua*) the conception is always formed in the *Cornua*, as being the greatest part of the *Uterus* which from the very orifice of its *Fundus* is presently divided into them, as when one parts the fore

fore from the middle finger as wide as one can) but very rarely in the *Tubæ* in Women, but most an end in the *Fundus* it self. Of which more in Ch. 30.

Arteries.

Its *Arteries* spring partly from the *Spermatick* or *Præparantes*, and partly from the *Hypogastrick*. These two *Arteries* do on each side by a notable branch inosculate one with the other. And both their branches that run on one side the Womb, do inosculate with those of their own stock on the other. Which may plainly be seen by blowing into the trunk of either of them on which side you will, for then the branches on the other side will be puffed up, as well as those on that side you blow.

They run along the Womb not with a streight or direct course but bending and winding, that they may be extended without danger of breaking when the Womb is enlarged to so great a bulk by the *Fætus*. By these *Arteries* it is that the *Menses* flow, in greatest quantity out of those that open into the *Uterus* it self, but in lesser out of those branches that reach and open into the *Cervix* or neck of the Womb, and in least (if at all) out of the *Vagina*. Now whether the Blood be sent forth this way at such times onely from the too great quantity of it; or whether at such stated seasons there is also a fermentation of the Blood whereby the orifices of the *Arteries* are unlocked, is a controversie of two large consideration for this place. We will onely say that the latter is more probable, because when a Woman feeds high, and so breeds much Blood, they flow never the sooner (though it may be in greater quantity) and when she uses the greatest abstinence and spareness of diet (if she be healthfull) they will be never the longer of coming. So that
when

when through such effervescency the Blood flows plentifully into the Uterine vessels, and the Veins of the Womb being too few (for they are fewer than the Arteries) to return it all back again by the circulation, it bursts forth of the extremities of the Arteries so long, till the too great quantity of the Blood be lessen'd and the fermentation ceases, which it does ordinarily after three or four days, and so the flux stops till the next period. In Women with Child they seldom flow, either because the redundant Blood is then bestowed on the nourishment of the *Fetus*, according to the old hypothesis; or according to the new, because it is defrauded of a considerable part of the Chyle (or nutritious juice) which is consumed by the *Fetus*, whereby it becomes diminished and depauperated. But of this also more in Chap. 30.

The *Veins* do likewise spring from the *Præpa-Veins*. *vantes*, and from the Hypogastrick. There are many anastomoses of these Veins one with another, (as there was noted of the Arteries) but especially in the sides of the *Uterus*, which do more readily appear by blowing of them up, than those of the Arteries above spoken of. The Blood brought hither by the Arteries, that is not spent on the ordinary nutrition of the Womb, or is not cast out when the *Menses* flow, returns by these Veins back to the Heart.

It has *Nerves* from the *Plexus mesenterii* *maxi-Nervos.* *mus* of the Intercoastal pair, and from the lowest *Plexus* of the same. As also from the Nerves of *Osfacrum*. And the same run also to the *Testes* or *Ovaria*. Now it is these *Plexus* of Nerves that are chiefly affected in the Hysterical passion, or Fits of the Mother. For these Fits are merely
Con-

Convulsive, and often happen without any fault of the Womb at all. And that symptom that in such Fits is usual, namely when something like a Ball seems to rise from the bottom of the Belly and to beat strongly about the Navel (which is usually taken by Women for the rising of the Womb or Mother) is nothing but the convulsion of these Plexus of Nerves: which one will rather believe, when he considers that some Men are afflicted with the same symptom. Of which see more in Dr. Willis (*in Cerebr. anat. p. 201.*) who derives the pain of the Colick also from the same cause.

Lympheducts.

De Graef says there are many *Lympheducts* that creep through the outer substance of the Uterus, which one after another meeting into one, empty themselves into the common Receptacle: And these, he says, Bartholin mistakes for *Venæ lacteæ*.

Use.

The use of the Womb is to receive into its capacity the principles of the formation of the *Fetus*, to afford it nourishment, to preserve it from injuries, and at length when it is grown to maturity and requires the light and a freer air, to expell it forth.

The neck of the Womb.

The *Cervix* or *Os internum* of the Womb being continuous to it and coming betwixt it and the *Vagina*, we will treat of it in this Chapter. It seems to be a part of the *Fundus* or of the Womb properly so called, onely it is much narrower, for its Cavity is no wider in Virgins than a small Quill, and in Women with Child its inner orifice doth either quite close its sides together, or is daub'd up with a slimy yellowish humour, so that nothing can then enter into the Womb, unless

less in very lustfull Women it be sometimes open'd in superfoetation. It is an inch or more in length. Its Cavity as it opens to the *Vagina* is compared to the mouth of a Trench; *Galen* likens its passage to that in the *Gland* of a Man's *Penis*; for it is not round, but long and transverse. It is wrinkled, and has many small ducts opening into it, out of which one may press a puitous ferous matter. It has the same Membranes and the same Vessels with the *Uterus* it self. *De Graef* says that amongst its wrinkles he has often observed *Hydrides* or little watry Bladders; and thinks, that a boyesaid ferous matter serves onely to moisten the *Vagina*, &c. and to excite to Venerie.

C H A P. XXVIII.

Of the Vagina, and its Contents, viz. the Hymen and Carunculae myrtiformes.

Continuous unto the *Cervix* is the *Vagina* so called, because it receives the *Penis* like a Sheath. It is called also the door of the *Womb*, and its greater Neck, to distinguish it from the lesser just now described in the foregoing Chapter.

It is a soft and loose Pipe, uneven on its inside with orbicular wrinkles, of a nervous but somewhat spongy substance (which it causes to puff up a little, that it may embrace the *Yard* more closely) about seven fingers breadth long, and as wide as the straight Gut: all which yet, both length, width and looseness differ in respect of age, &c. and as a Woman is inflam'd more or less

Vagina.

Its name.

Descripti-
on.

less with lust. So also the aforesaid wrinkles are much more numerous and close set in Virgins, and in Women that seldom accompany with a Man, and that have never born Children, than in those that have born many Children, and in Whores that use frequent copulation, or those that have long laboured under the *fluor albus*, for in all these three sorts they are almost obliterated. Its thickness on the upper side, (according to *De Graef*) is about a straw's breadth; but on its lower it is twice as thick. *Stockhamer* says, it consists of a spongy and glandulous substance, through which not onely plentiful branches of Veins and Arteries, (*viz.* from the hypogastrick and hemorrhoidal) are dispersed, as also Nerves from the *Os sacrum*; but it has also proper excretory ducts, which gape like pores into its inner cavity, and are most numerous near the urinary passage. And this substance, he says, is contained between two Membranes, of which the inner is nervous and wrinkled; the outer, carnous.

Vessels.

It has very many Arteries and Veins, some of which inosculate one with another, and others not. By the Arteries that open into it do the *Menses* sometimes flow in Women with Child that are plethorick; for they cannot come from the Womb it self, unless abortion follow, as sometimes it does. These Vessels bring plenty of Blood hither in the venereal congress, which heating and puffing up the *Vagina* encrease the pleasure, and hinders the Man's Seed from cooling before it reach the *Uterus*. They spring not onely from the Hypogastrick but also from the Hemorrhoidal, but these latter run onely through the lower part of the *Vagina*. Its Nerves *Dr. Willis* thus describes: From the lowest plexus of the

the *Abdomen* two Nerves are sent into the *Pelvis*, where each receives a notable vertebral Nerve; and so they make two *plexus*, one on each side: from which there arise two ascending Nerves that run to the *Intestinum rectum*, and two descending that are carried to this part we are speaking of.

Near its outer end, between the *Nymphae* (of *The insertion of the Neck of the Bladder.* which in the next Chapter) in its fore and upper part it receives the neck of the Urinary bladder encompassed with its Sphincter: opposite whereto in its hinder or lower part it is strongly knit to the Sphincter of the streight Gut. The urinary passage, or *urethra*, is not above two fingers breadth long from the neck of the Bladder to its end, and about as thick as a Goose-quill.

The *Hymen* is a thin Nervous membrane interwoven with carnous Fibres, and endowed with many little Arteries and Veins, spread across the duct of the *Vagina*, behind the insertion of the neck of the Bladder, with a hole in the midst that will admit the top of ones little finger, by which the *Menses* flow. It is otherwise called the *Zone* or *Girdle of Chastity*. Where it is found in this form described, it is a certain note of *Virginity*; but upon the first congress with a Man it is necessarily violated, which is usually accompanied with an effusion of blood; which Blood is called the *Flower of Virginity*; and of this the holy Text makes mention in *Deuterom. 22. verses 13. — 21.* And when once it is broke, it never closes again.

But though this effusion of blood upon coition from the rupture of this membrane (or perhaps of capillary vessels in the *vagina*) be a certain

N

token

token of Virginity; yet it will not follow on the contrary, that where it is wanting, Virginity is also wanting. For the *Hymen* may be corroded by acrimonious fretting humours flowing through it with the *Menses*; or may be violated by the falling out or inversion of the *Uterus* or the *Vagina* at least, which sometimes happens even to Maids; or lastly, perhaps the indiscreet and unwary Bride has had her *Menses* a day or two before, in which case both the *Hymen* and the inner wrinkled Membrane of the *Vagina* are so flabby and relaxed, that no such rupture, and by consequence no such effusion may happen.

In some there naturally wants a *foramen* in the *Hymen*, by which means there being no exit for the *Menses*, such are in great peril of their life if they be not relieved by Surgery, viz. by opening it with some sharp instrument.

Carunculae myrtiformes.

Close to the *Hymen* lie the four *Carunculae myrtiformes*, so called from their resembling Myrtle-berries. The largest of them is uppermost, standing just behind the mouth of the urinary passage which it helps to shut. Opposite to this in the bottom of the *Vagina*, there is another, and on each side one, so that they stand in a square. But of these there is only the first in Maids, the other three are not indeed Caruncles, but little knobs made of the angular parts of the broken *Hymen* roll'd into a heap by the wrinkling of the *Vagina*, according to *Riolanus* and *Diemerbroeck*. These three when the *Vagina* is extended in a Womans labour, lose their asperity and become smooth, so that they disappear, untill it be again contracted to its natural straitness.

De Graef affirms, "that the *Vagina* near its
" outer

“outer orifice has a Sphincter muscle almost
 “three fingers broad, that upon occasion con-
 “strings or contracts it. Which constriction is
 more particularly described by *Stockhamer*, who
 says “it is performed partly by means of the
 “fibres that run through the outer carnosus coat
 “of the *Vagina*; and partly by this sphincter
 “Muscle, and two net-like *plexus* which in their
 “composition are like the nervous bodies of the
 “*Penis*, or of the *Clitoris*; for they consist of ves-
 “sels and fibres water’d with black blood, and
 “clad with a thin membrane; they climb on ei-
 “ther side of the *vagina* near its outer orifice, and
 “notably help to constringe it when they are put
 “up with spirituos blood in coition; for by
 “their swelling they drive the sides of the *vagina*
 “inwards; which that they may the better do,
 “the sphincter muscle (ascending from the
 “sphincter of the *Anus*) doth outwardly cover
 “these *plexus*, that by its constriction it may hin-
 “der them to swell outwardly.

Having thus described the parts of the *Vagina*,
 its use is easily declared to be, to receive the Man’s
 Yard, being erect, to direct and convey the Seed
 into the Womb, to serve for a Conduit by which
 the *Menses* may flow out, and to afford a passage
 to the *Fetus* in its birth, and to the After-
 birth.

C H A P. XXIX.

Of the Pudendum muliebre, or Woman's Privity.

THE parts that offer themselves to view without any diduction are the *Fissura magna* or great Chink, with its *Labia* or Lips, the *Mons Veneris* and the Hairs. These parts are called by the general name of *Pudenda*, because when they are bared they bring *pudor* or shame upon a Woman.

Fissura.

The great Chink is called *Cunnius* by *Galen*, à view to conceive; by *Hippocrates*, *Natura*. It is also called *Vulva*, *Porcus*, *Concha*, and by many other names that fancy has imposed upon it.

It reaches from the lower part of *Os pubis* to within an inch of the *Anus*; being by Nature made so large, because the outward Skin is not so apt to be extended in travail as the membranous *Vagina* and *Collum minus* are. It is less and closer in Maids than in those that have born Children. Its length makes the *Perinaeum* not to be above an inch long. It has two Lips, which towards the *Pubes* grow thicker and more full or protuberant, and meeting upon the middle of the *Os pubis* make that rising that is called *Mons Veneris*, or the Hill of *Venus*.

Mons veneris.

The inner substance of this Hill, which makes it bunch so up, is most of it fat; and under the fat lies that sphincter Muscle that we spoke of in the last Chapter, that constringes the orifice of the *Vagina*, and springs from the *Sphincter ani*.

By

By a little drawing aside the *Labia* there then appear the *Nymphæ* and the *Clitoris*.

The *Nymphs* are so called because they stand next to the Urine as it spouts out from the Bladder, and keep it from wetting the *Labia*. They are called also *ἄλγυα* or Wings. They are placed on each side next within the *Labia*, and are two carious and soft productions, beginning at the jointing of the *Ossa pubis* or upper part of the Privy (where they are joined in an acute angle, and make that wrinkled membranous production that clothes the *Clitoris* like a *Præputium* or Foreskin) and descending, close all the way to each other, when the *Pudendum* is shut, reaching but about half the breadth of the orifice of the *Vagina* and ending each in an obtuse angle. They are almost triangular, and therefore, as also for their colour, are compared to the thrills that hang under a Cock's throat.

They have a red substance, partly fleshy, partly membranous; within soft and spongy, loosely composed of small Membranes and Vessels, so that they are very apt to be distended by the influx of the Animal spirits and Arterial blood. The spirits they have from the same Nerves that run through the *Vagina*, and Blood from that branch of the inner Iliacal artery that is called *Pudenda*: Veins they have also from the *Venæ pudendæ*, which carry away the Arterial blood from them when they become flaccid. They are larger in grown Maids than in younger, and larger yet in those that have used Venery or born Children.

Their use is to defend the inner parts, to cover the urinary passage, and a good part of the orifice

fice of the *Vagina*. And to the same purposes serve the *Labia* above described.

Clitoris.

Above betwixt the *Nymphae* in the upper part of the *Pudendum* does a part jet out a little that is called *Clitoris*, from *κλειστός*, that signifies lasciviously to grope the *Pudendum*. It is otherwise called *Virga*, for it answers to a Man's Yard in shape, situation, substance, repletion with spirits and erection; it has nervous bodies, a *septum*, a *glans*, muscles and the like vessels with the *Penis*. But it differs therefrom, first in magnitude; for this is very small in respect to that, as being not to be blown up to the thickness of ones little Finger. Secondly, the forked roots of the nervous bodies that lie hid within the fat of the *Pubes*, are twice as long as that part of it which is united into one body with the *septum* between; whereas on the contrary in the *penis* the united part is four times as long as the forked. Thirdly, the *Clitoris* wants an *urethra*, and its prominent *glans* wants a *foramen*. Fourthly, it has onely one pair of Muscles. In some its united part grows to that length, as to hang out from betwixt the Lips of the *Pudendum*: yea there are many stories of such as have had it so long and big as to be able to accompany with other Women like unto Men, and such are called *Fricatrices*, or otherwise *Hermaphrodites*; who it is not probable are truly of both Sexes, but onely the *Testes* fall down into the *Labia*, and this *Clitoris* is preternaturally extended. But in most it jets out so little as that it does not appear but by drawing aside the *Labia*.

Its substance.

It is a little, long and round body, consisting (like a Man's *Penis*) of two nervous and inwardly black and spongy parts, that arise on each

each side from the bunching of the *Os Ischium*, and meet together at the jointing or conjunction of the *Ossa pubis*. It lies under the fat of *Mons Veneris*, in the top of the great fissure. In Veneris by means of the two nervous bodies it puffs up, and straitening the orifice of the *Vagina* contributes to the embracing of the *Penis* the more closely.

Its ouer end is like to the *Glans* of a Man's *Glans*. Yard, and has the same name, (as also *Tentigo*.) And as the *Glans* in Men is the seat of the greatest pleasure in copulation, so is this in Women; whence it is called *Amoris dulcedo* and *astrum Veneris*. It has some resemblance of a *Foramen*, but it is not pervious. It is most of it covered with a thin Membrane from the conjunction of the *Nymphæ*, which for its likeness to the *Præputium* in Men, is also called so.

The *Clitoris* has formerly been affirmed to have two pair of *Muscles* belonging to it. The upper are round, and spring from the Bones of the *Coxendix*, and passing a little way along the two nervous bodies above-described are inserted into them. These by straitning the roots of the said bodies do detain the Bloud and Spirits in them, and so erect the *Clitoris*, even as those in Men do the *Penis*. The other arise from the *Sphincter ani*, and are those we mention'd above in the end of the foregoing Chapter: for though they have been thought to serve for the erection of the *Clitoris*, yet we think with *de Graef* that they are rather of the nature of a sphincter, and contribute to the pursing up or constringing the ouer orifice of the *Vagina*.

It has *Veins* and *Arteries* from the *Pudenda*, and *Vessels*. *Nerves* from the same origine with the *Vagina*, which are pretty large.

Its use may be known from what has already been discoursed. And we will only note further, that in some Eastern Countries it uses to be so large, that for its deformity and the hindrance it gives to copulation, they use to cut it quite out, or hinder its growth by searing it, which they improperly call Circumcision.

Tab. IX.

Fig. I. representeth the Genital parts of a Woman taken out of the Body, and placed in their natural situation.

AA The trunk of the great Artery.

BB The trunk of the Vena cava.

C The right Emulgent vein.

D The left Emulgent vein.

E The right Emulgent artery.

F The left Emulgent artery.

GG The Kidneys.

HHHH The Ureters as they arise from the kidneys and are inserted into the bladder, but their middle part cut off.

III The right Spermatick artery.

KK The left Sparmatick artery.

LL The right Spermatick vein.

MM The left Spermatick vein.

NN The Iliack arteries.

OO The Iliack veins.

PP The inner branches of the Iliack artery.

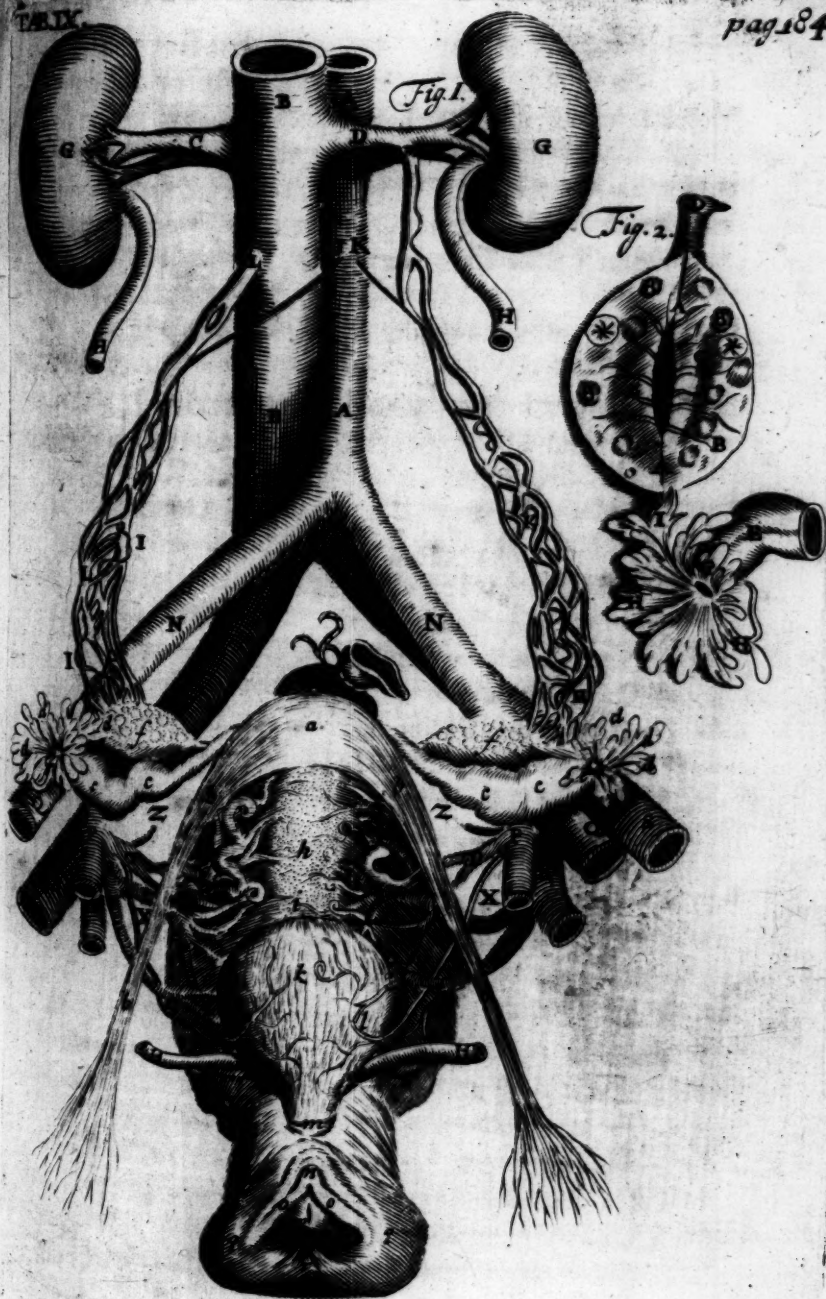
QQ The outer branches of the Iliack artery.

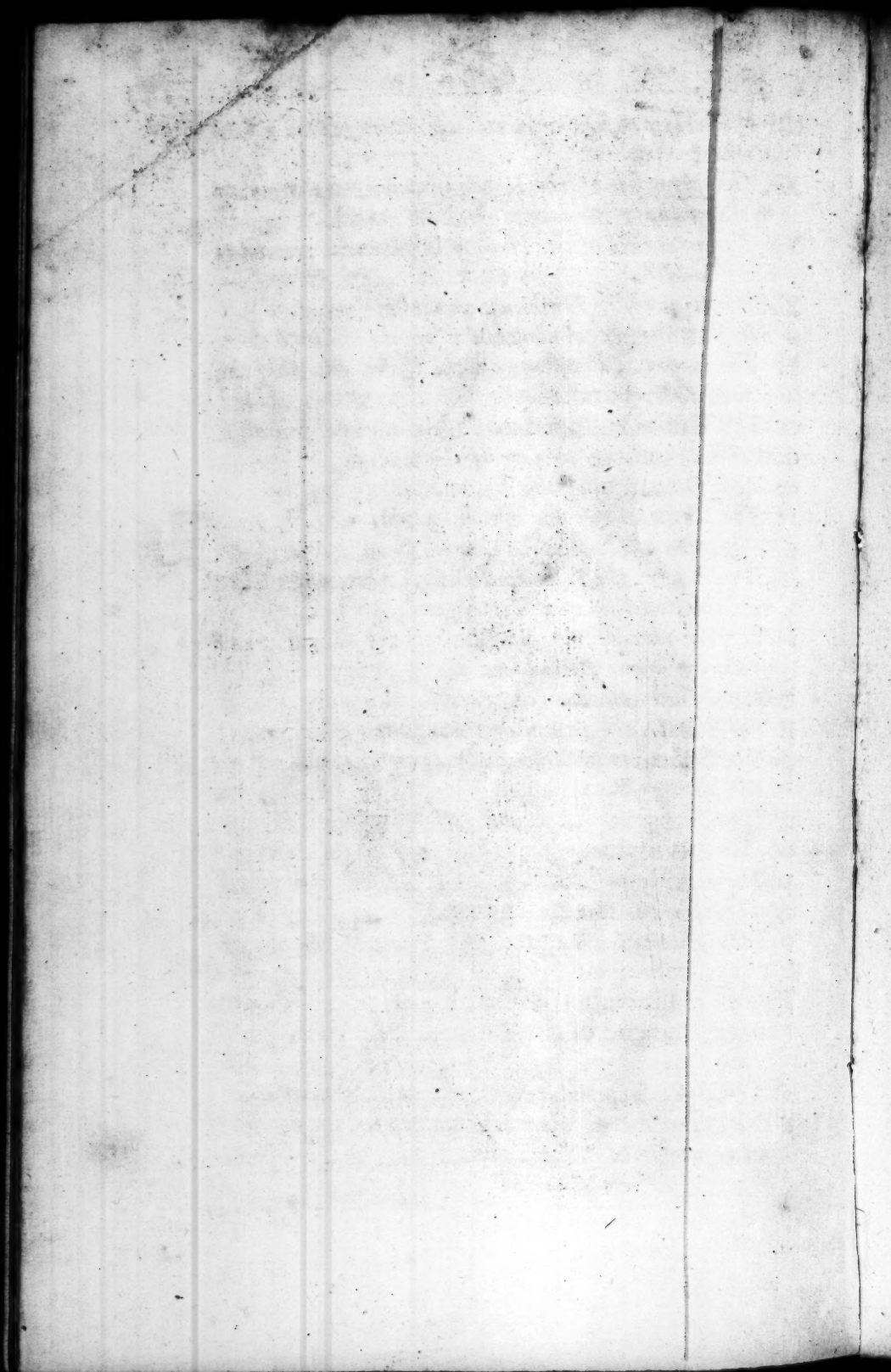
RR The inner branches of the Iliack vein.

SS The outer branches of the Iliack vein.

TT The Hypogastrick arteries carried to the Womb and Vagina.

UU The





III The Hypogastrick veins accompanying the said arteries.

XX The branches of the Hypogastrick artery tending to the urinary Bladder.

YY The branches of the Hypogastrick vein carried to the Bladder.

ZZ Portions of the Umbilical arteries.

a The Fundus uteri cloathed with its common Coat.

bb The round Ligaments of the Womb as they are joyned to its Fundus.

cc The Tubæ Fallopianæ in their natural situation.

ddd The Fimbriæ or jags of the Tubæ.

ee The Foramina of the Tubæ.

ff The Testicles in their natural situation.

g A portion of the streight Gut.

h The neck of the Womb, divested of its outer Coat, that the Vessels may be better seen.

i The fore-part of the Vagina of the Womb, freed from the urinary Bladder.

k The urinary Bladder contracted.

ll The Bloud-vessels running through the Bladder.

m The Sphincter muscle constringing the neck of the Bladder.

n The Clitoris.

oo The Nymphæ.

p The urinary passage.

qq The Lips of the Pudendum.

r The orifice of the Vagina.

Fig. 2. exhibiteth a Woman's Testicle or Ovarium with the end of the Tuba annexed to it.

A The Testicle opened lengthways in its lower part.

BB Eggs of divers bigness contained in the membranous substance of the Testes.

CC The

CC *The Bloud-vessels in the middle of the Testes, proceeding plentifully from its upper part, as they run to the Eggs.*

DD *The Ligament of the Testicles, whereby they are knit to the Womb, cut off.*

EE *A part of the Tuba Fallopiana cut off.*

F *The Cavity of the Tuba cut off.*

GG *The hole that is in the end of the Tubæ.*

H *The leavy ornament of the Tubæ.*

I *The leavy ornament of the Tubæ knit to the Testes.*

C H A P. XXX.

Of a Conception.

HAVING described all the parts that serve for Generation both in Man and Woman, order would, that we should speak of the *efficient causes, matter or principles* from whence that which is generated by and in them, doth proceed. And in the first place there occurs the Man's Seed, which is the *active principle or efficient cause* of the *Fetus*; but when we discoursed of the *Testes*, we shewed what the matter of it was, *viz.* Arterial bloud and Animal spirits; and as to the manner of its fecundating the *Ovum*, we omit that as being too philosophical for this place. In the next place therefore we must come to the *matter or passive principle* of the *Fetus*, and this is an *Ovum* impregnated by the Man's Seed. And here because in Women it cannot be observed by what degrees and in what time an *Ovum* in the *Ovarium* or *Testis* becomes a Conception in the
Uterus,

Uterus, we must be forced to guess at that by the analogy in other Creatures. To this purpose Dr. *Harvey de generatione Animalium* is worthy to be read of the curious ; especially concerning the manner and order of the generation of the parts of a Chicken in an Hens Egg, in his *Exercit.* 56. But when he comes to apply this to the Conceptions of viviparous Animals, being ignorant that there was any formal *Ovum* pre-existing in them, and onely then fecundated, he runs into great errors and odd notions about Conception: imagining an analogy betwixt the Brain's forming its Phantasms or Conceptions, (which he calls Animal) and the Wombs forming hers, which he calls Natural. He rightly indeed rejects the Hypothesis of the Womans having true Seed, as also the notion that the Man's Seed is any part of the Conception; but then he gives an unsatisfactory account of it when he says it is formed of the primeval albugineous humours that transude into the *Cornua* in Brutes or *Uterus* in Women, after they are impregnated or matur'd, as he speaks. For those albugineous humours (as shall be shown more fully afterwards) are not the first principle from which the *fetus* is formed, but the matter whereby its lineaments first drawn within the *ovum*, receive their increase and perfection. I shall not therefore rehearse the history of generation in Harts that he has given us, for an analogical explication of that in Women; but shall transcribe the observations of the curious *de Graef* concerning the generation of Rabbits, as being more adapted to our purpose, and more consonant to truth.

"We made the first trial, (says he) on a female"

"male"

" male Rabbet that had not yet accompanied with
 " the male. Dissecting which we observed a very
 " wide *Vagina* and about eight fingers breadth
 " long; which being opened lengthways, there
 " stood out two narrow mouths in its upper part
 " divided with a semilunar partition, namely the
 " beginning of each *Cornu*: for the Womb in
 " Conies is presently from the very *Vagina* divi-
 " ded into two parts, one of which bends to-
 " wards the right hand, the other towards the
 " left about three fingers breadth asunder, where
 " they are presently contracted and continued
 " with the Oviducts, which in these Animals
 " have a peculiar situation (or make) because
 " if you lightly blow up the *Cornua* these will not
 " swell, nor the wind penetrate them because of
 " some loose *Fimbriae* or jags closing like the valve
 " of the Gut *Colon*. These Oviducts being small
 " at their rising from the *Cornua*, for five fingers
 " breadth run with a winding duct beyond the
 " Testicles, widening more and more by degrees,
 " and then they turn back towards them and end
 " in the form of a Tunnel The Testicles are
 " small, but contain very many limpid Eggs,
 " which being cut open there issued out a clammy
 " liquor like the white of an Egg. This being
 " premised,

" We opened another half an hour after the
 " coitus, the *Cornua* of whose *Uterus* lookt a little
 " redder, but the *Ova* in the Testicles were not
 " yet chang'd, unless they had remitted a little
 " of their clearness: but neither in the *Vagina*
 " nor in the *Cornua* could we perceive any Seed or
 " any thing like it.

" About six hours after the coupling we dissec-
 " ted another, in whose Testicles the *Folliculi* (or
 " Cases

“Cases) of the *Ova* inclined to redness, out of
“which being pricked with a needle a clammy and
“clear liquor issued first, but blood followed,
“flowing out of the Sanguinary vessels dispersed
“through the *Folliculi*: We could find no Seed
“neither in this Coney.

“Four and twenty hours after the *coitus* we
“opened another, in one of whose Testicles we
“found three, and in the other five *Folliculi* of
“the *Ova* very much changed; for being before
“limpid and colourless, they were now turn’d
“dusky and of a faint red, in the middle of
“whose superficies a little *Papilla* (or Teat) as
“it were discover’d it self: when the *Folliculi*
“were cut open, there appear’d a little limpid
“liquor in their middle, and in their circumfe-
“rence a certain thicker and reddish matter.

“Twenty seven hours after the *coitus* we in-
“spected another, the *Cornua* of whose *Uterus*
“with the Oviducts looked more bloody, also
“the extremity of the Oviduct did on every side
“embrace the *Testes* like a Tunnel; in the mid-
“dle superficies of the *Folliculi*, as in those be-
“fore, there stood out little *Papillæ*, through
“which by pressing the substance of the Testicles
“there issued a limpid liquor, which was follow-
“ed by another redder and thicker. Opening
“the *Cornua* of the Womb we found no Eggs, but
“the inner wrinkled tunicle of the *Cornua* was a
“little more rumid.

“Eight and forty hours after the *coitus* we exa-
“min’d another, in one of whose Testicles we
“found seven, in the other three *Folliculi* char-
“ged, in whose middle the *Papillæ* were some-
“thing more eminent, through which, by pres-
“sing the substance of the Testicles, there issued

" a little liquor like the white of an Egg, but the
 " remaining reddish substance of the *Ova*, being
 " now become something thicker, was not so ea-
 " sily pressed forth as in those before.

" Two and fifty hours after the *coitus* we view-
 " ed another, in one of whose Testicles we found
 " one, in the other four *Folliculi* altered ; cutting
 " open which we found a glandulous-like matter,
 " in the middle of which there was a little Cavity,
 " wherein finding no notable liquor, we began to
 " suspect whether or no their limpid substance,
 " which is contained in proper membranes, were
 " burst forth or expelled : wherefore we searched
 " carefully both the Oviducts and the *Cornua*, but
 " we could find nothing ; onely the inner tunicle
 " of the *Cornua* being much pufft up shined.

" Seventy two hours (or three days and
 " nights) after the *coitus* we inspected another,
 " which exhibited a far other and most wonder-
 " full change ; for the *Infundibulum* did embrace
 " the Testicles on every side most closely, which
 " being pull'd off we found in the Testicle of the
 " right side three *Folliculi* a little greater and
 " harder, in the middle of whose superficies we
 " saw a tubercle with a little hole in it like a *Pa-*
 " *pille* ; but dissecting the said Cases through the
 " middle, their Cavity was quite empty ; where-
 " fore we searched the ways through which the
 " *Ova* must pass, again and again, and found in
 " the middle of the right Oviduct one, and in the
 " outer end of the *Cornu* of the same side two very
 " small Eggs, little bigger than small pins heads,
 " which notwithstanding their smallness are clea-
 " rthed with a double Coat ; out of these Eggs
 " being pricked there issued a most limpid liquor.
 " In the very beginning of the *Cornu* of
 the

“ the left side we found onely one Egg, just like
 “ those small ones of the other side : whence it is
 “ clear that the *Ova* excluded out of the *Testes*
 “ are ten times less than those that yet stick in the
 “ *Testes* ; which seems to us to come to pass in-
 “ asmuch as those that are still in the *Testes* con-
 “ tain as yet another matter , namely that of
 “ which the glandulous substance of the *Cases* is
 “ made.

“ The fourth day from the *coitus* we opened a-
 “ nother, in one of whose *Testicles* we found
 “ four, in the other three *Globules* or *Cases* emp-
 “ tied ; and in the *Cornua* of the respective sides
 “ we found as many Eggs, greater than the for-
 “ mer, which did not stick in the *Oviducts* or be-
 “ ginnings of the *Cornua*, but were now rolled on
 “ towards their middle : in their Cavity we be-
 “ held as it were another Egg swimming, far
 “ clearer than in the other before

“ The fifth day from the *coitus* we dissected a-
 “ nother, in whose *Ovaria* or *Testicles* we told six
 “ emptied *Folliculi*, that had each a notable *Pa-*
 “ *pilla*, through whose *Foramen* we easily put an
 “ ordinary bristle into their Cavity : we found
 “ also the same number of Eggs (bigger than
 “ those the day before) in divers parts of the
 “ *Cornua*, in which they lay so loosely, that by
 “ blowing onely, one might drive them this way
 “ or that way. The inner ransle of these (or
 “ the Egg within an Egg as it were) was become
 “ yet more conspicuous.

“ The sixth day after the *coitus* we examin'd
 “ another, in one of whose *Testicles* we observ'd
 “ six *Cases* emptied, and in the *Cornu* of the same
 “ side we could sight of but onely five Eggs near
 “ the *Vagina*, brought as it were upon a heap:
 but

" but in the Testicle of the other side we found
 " four *Folliculi* emptied, and in the *Cornu* of that
 " side onely one Egg: The cause of which difference
 " we suppose to be, either because some
 " Eggs by the wave-like motion of the *Cornua*
 " (not unlike the peristaltick motion of the
 " Guts) being carried downwards towards the
 " *Vagina* were driven forth; or because being
 " consumed in the *Folliculi* they came not to the
 " *Uterus*; or light on some other mischance.
 " These Eggs were as big as small Pease.

" The seventh day from the *coitus* we examin'd
 " another, in whose *Ovaria* we found some *Folliculi*
 " emptied that were greater, redder and
 " harder than the foregoing, and saw as many
 " transparent Tumours or Cells in divers parts of
 " the *Uterus*; out of which being opened we turn'd
 " *Ova* as big as Pocket-pistol Bullets, in
 " which we beheld nothing but the Inner tunicle
 " very conspicuous and a most limpid humour.
 " It is to be wondred at, that in so short a space
 " of time the Eggs should imbibe so great plenty
 " of liquor, that whereas before they might easily
 " be taken out of the Womb, now they could
 " very difficultly.

" The eighth day from the *coitus* we opened
 " another, in the right *Cornu* of whose *Uterus*
 " we saw one, in the left two Cells; one of these
 " was almost twice as big as the other: for Nature
 " doth sometimes so vary, that there are Eggs of
 " divers bigness found not onely in divers Animals
 " of the same species dissected at the same distance
 " from the *coitus*, but also in one and the same Individual.
 " In the horns of the Womb being
 " opened we saw the Eggs a little bigger than the
 " day before, but all of them, their tunicles
 breaking,

“breaking, poured out their clear liquor before
“we could take them quite out : for which rea-
“son we tried another dissection likewise the
“eighth day after the *coitus* ; the right *Cornu* of
“whose *Uterus* we saw swelled up into two, and
“the left into four transparent Tumours or Cells,
“out of which that we might take the *Ova* we
“used the greatest diligence and attention ; but
“as soon as we came to them, their tunicles were
“so very tender that they burst as the former :
“which when we saw, the Eggs that remained
“we boiled with the *Uterus*, whereby their con-
“tents harden’d like the whites of Hens Eggs.
“The inner substance of the Cells, on that side
“whereon it receives the Hypogastrick vessels,
“was become more tumid and red.

“The ninth day after the *coitus* we dissected a-
“nother that was old ; the Testicles of this were
“almost as big again as those of younger : in the
“right we saw two, in the left five *Folliculi* lately
“emptied, and besides these, others that lookt
“very pale, which we judged to be those that had
“been emptied the *coitus* before this, although
“for the most part they leave onely some palish
“points or specks, to which the increase of the
“Testicles is owing. The *Folliculi* of the last
“*coitus* were each beset with a *Papilla*, but the
“others were smooth. In the right *Cornu* there
“were two, and in the left five Cells, whose sub-
“stance being more rare and pellucid than the
“other parts of the *Uterus*, was interwoven with
“many twigs of Veins and Arteries. Opening
“some of these Cells, we could see the *Ova*, but
“could not take them out whole ; wherefore be-
“ing compelled to examine the content of the
“Eggs in the very hollow of the Cells, we found

O

“ it

" it clear like Crystal ; in the middle whereof a
 " certain rare and thin cloud was seen to swim,
 " which in other Conies dissected likewise on the
 " ninth day after the *coitus*, for its exceeding fine-
 " ness escaped our sight. The inner substance of
 " the Cells, namely that which receives the Hy-
 " pogastrick vessels, being more tumid than the
 " rest, exhibited the rudiments of the Pla-
 " centæ.

" The tenth day after the *coitus* we inspected
 " another, in whose right Testicle we found one
 " onely *Folliculus* emptied, which by reason of
 " the Sanguineous vessels dispersed plentifully
 " through it was redder and had a less *Papilla* ;
 " in the middle of this pale substance there ap-
 " pear'd as yet a very small Cavity : but in the
 " left Testicle we found six such *Folliculi*. In the
 " *Cornua* of the *Uterus* we found also so many
 " Cells, namely one in the right and six in the left,
 " distant a fingers breadth one from another, in
 " the middle of which Cells lay a rude mucilagi-
 " nous draught of the *Embryo* like a little Worm.
 " One might also plainly discern the *Placenta* to
 " which the Egg by means of its *Chorion* was an-
 " nexed. The matter of the Eggs boil'd with
 " the Womb hardned like the white of an Egg,
 " and tasted like the boiled congealed substance of
 " the Eggs in the Testicles.

" The twelfth day after the *coitus* we opened
 " another, in one of whose Testicles we found se-
 " ven, in the other five *Folliculi* emptied, and as
 " many Cells in the *Cornua* much bigger and
 " rounder than the foregoing, in the middle of
 " which the *Embryo* was so conspicuous, that one
 " might in a sort discern its Limbs. In the region
 " of its breast two sanguineous specks and as
 " many

"many white ones did offer themselves to view :
 "in the *Abdomen* there grew a certain mucilagi-
 "nous substance inclining here and there to red.
 "We could not discern more in this shapeless lit-
 "tle Animal because of its tenderness.

"The fourteenth day after the *coitus* we dissec-
 "ted another, the Cells of whose *Uterus* we be-
 "held to be yet greater, and their Sanguineous
 "vessels more, and more turgid : we also noted
 "that the Cells the larger they grew, came also
 "nearer to one another, and their Interstices
 "were lessened. The Membranes *Ammios* and
 "*Chorion* were knit together, which though they
 "appear thicker and stronger, are yet more hard
 "to be separated from one another than in the
 "*Ova* taken intirely out of the Womb ; tearing
 "these we saw an *Embryo* with a great and pellu-
 "cid Head, with the *Cerebellum* capped, its
 "goggle Eyes, gaping Mouth, and in some sort
 "its little Ears might be discovered also. Its
 "Back-bone was drawn out, of a white colour,
 "which bending in about the *Sternum* resembled
 "a Ship ; by whose sides most slender Vessels run,
 "whose ramifications were extended to the Back
 "and Feet. In the region of the Breast two san-
 "guineous specks greater than the foregoing ex-
 "hibited the rudiments of the ventricles of the
 "Heart ; at the sides whereof were seen two
 "whitish specks for Lungs. In the *Abdomen* be-
 "ing opened, there first shew'd it self a reddish
 "Liver ; then a white Body, to which was knit
 "a mucilaginous matter like a writhed thread,
 "being the rudiments of the Stomach and Guts.
 "All which in those that we dissected afterwards
 "had acquired onely a greater bulk and perfec-
 "tion And therefore to prevent tediousness by re-

“ peating the same things, we will on purpose
 “ pass by all the other dissections we made in this
 “ kind of Creature, excepting only one which we
 “ made the day before the kindling; that those
 “ things that in the former were only confusedly
 “ discerned, may appear plain in this.

“ At length on the twenty ninth day after the
 “ *coitus* we inspected another, that had kindled
 “ six weeks before, and in the *coitus* by which she
 “ was impregnated had voided all the thicker
 “ part of the Seed of the Male, which in some
 “ measure did resemble the consistence of a most
 “ limpid jelly. In her *Ovaria* we found eleven
 “ little whitish *Folliculi*; and besides these, others
 “ far less, little or nothing differing from the
 “ substance of the *Testes*. The *Folliculi* of the
 “ *Ova* in the *Testes* seem not to vanish wholly,
 “ but to leave a certain speck in them; whence it
 “ certainly comes to pass, that Conies, the oft-
 “ ner or the more young ones they bring forth,
 “ have the greater and whiter Testicles; so that
 “ one may guess by onely viewing the *Testes*, whe-
 “ ther they have had many young ones or often.
 “ Having view'd the *Ovarium* we past to the *Ute-*
 “ *rus*, which we found no longer distinguish'd in-
 “ to Cells, but all along distended like a Pud-
 “ ding; which was so agitated with a wave-like
 “ motion, like the peristaltick of the Guts, that
 “ the young ones nearest the *Vagina* as yet inclu-
 “ ded in their Membranes were excluded, and
 “ that so hastily, that if we had not cut out the
 “ whole *Uterus*, they had all certainly gone the
 “ same way. The Womb was no thicker than
 “ when they are not with young, otherwise than
 “ we have said it to be in Women. In its Cavity
 “ we saw eleven *Fetus* sprawling, which were all
 “ so.

“so closely coupled together by the Membrane
 “*Ghorion* (wherein all are severally involved)
 “as if they had all been included in one and the
 “same *Ghorion* ————

Thus much I thought fit to translate of that accurate Anatomists observations concerning the generation of this sort of Animal, because it gives so very great light into the manner of the generation of a humane *Fetus*. For there is an exact analogy betwixt them, abating some circumstances; as *First* that in Women the Conception is not formed in the *Cornua*, seeing her Womb has none, nor in the *Tubæ* very seldom and according to nature, for they are onely the *Infundibula* or *Oviducts* to convey the *Ova* from the *Testes* to the *Fundus uteri*, though they bear some resemblance to the *Cornua* in Brutes; I say the Conception is not formed in these, but in the *Fundus uteri* or Womb properly so called, where into the *Ovum* being received presently begins to swell and grow bigger, and there appears as it were an Egg within an Egg, by means of the two Membranes with which it is cloathed; which Membranes are originally in the *Ovum* while it is in the *Testicle*, and imbibe the moisture that is sent now plentifully into the Womb, even as the little Yelks, in Hens, &c. gather the white about them in the *Oviduct* and *Uterus*, which they have none of in the *Ovarium*; or as Seeds in the Ground do imbibe the fertile moisture thereof to enable them to sprout. Another considerable circumstance wherein they differ is the slow procedure of the formation of the *Fetus* in Women in comparison of that in Conies now described. For seeing these go with young but 29 or 30 days, and Women nine months, we must imagine that the

Embryo is as perfectly formed in the former on the tenth day as in the latter in the tenth week, or longer. But I say abating these, or if there be any other such like circumstances, there is so great a likeness betwixt the one and other, that without insisting more on the matter or manner of the Conception, we shall pass on to the description of the parts that encompass the *Fetus*, then shew how it is nourished, and lastly what parts there are in a *Fetus* that differ from those in a Child born.

CHAP. XXXI.

Of the Placenta Uterina or Womb-liver, and Acetabula.

AFTER the Womb of a Woman with Child is cut open, the first thing that offers it self is the *Placenta uterina*, or Womb-cake, otherwise called *Hepar uterinum* or Womb-liver, from the likeness of substance, and also use according to those that imposed the name.

Its substance.

Its *substance* is very like that of the Spleen, only that is more brittle and this more tough and tenacious, so that it cannot so easily be separated from the Vessels. It is soft, and has innumerable Fibres and small Vessels. Its *Parenchyma* is partly glandulous, by means of which Glands the separation of humour that is made in it, is performed.

Shape and situation.

It is of very different *shapes* in several Creatures, but in Women it is circular, yet with some inequalities in its circumference. It is two fingers

gers breadth thick in its middle (but thinner near the edges) and a span or a quarter of a yard over from one side to the other when the *Fetus* is come to maturity ready for the birth. On that side next the *Fetus* it is smooth and something hollowish like Navel-wort, and is knit to the *Chorion*; but on that next the Womb it is very unequal, having a great many tubercles or bunchings whereby it adheres fast and immediately to the Womb. But to what part of it, is not agreed among Anatomists, some affirming it to grow to the fore-part, some to the hinder part; some to the left side, others to the right. Dr. *Wharton* (assenting to *Fallopian*) says, it always adheres to one of the two corners of the Womb (that answer in some manner to the *Cornua* in Brutes) whereinto the *Foramen* of the *Tuba* opens; so that he says the said *Foramen* is as it were the centre to the *Placenta*. *De Graef* thinks it is most commonly fasten'd there, but not always, because the *Ovum* for a while being loose in the Cavity of the *Uterus*, may be tumbled to this or the other part, and where-ever it fixes, there it is join'd to the Womb by the *Placenta*.

When there is but one *Fetus* in the Womb it is but one, but if there be Twins, then according to Dr. *Wharton*, &c. are there two *Placentæ*, either distinct in shape, or if they appear in the shape of one, then are they separated by a Membrane one from the other; and a particular rope of Umbilical vessels is inserted into each from each *Fetus*.

It grows not out of the Womb originally, but its first rudiments appear like a woolly substance on the outside of the outer Membrane that invests the *Embryo* (called *Chorion*) about the eighth or

ninth week, upon which in a short while a red, carnous and soft substance grows, but unequally and in little knobs, and then it presently thereby sticks to the Womb, and is very conspicuous about the twelfth or thirteenth week. Till now the *Fetus* is encreased and nourished wholly by the apposition of the crystalline or albugineous liquor wherein it swims loose in the inner Membrane (called *Amnios*) having no *Vasa umbilicalia* formed, by which to receive any thing from the *Placenta*. But when it waxes bigger, and begins to need more nourishment, the extremities of the Umbilical vessels begin to grow out of the Navel by little and little, and are extended towards this *Placenta*, that out of it, as Plants by their Roots out of the Earth, they may draw a more firm nutritive juice, and carry it to the *Fetus*. But of this more in the 33^d Chapter.

Vessels.

It has *Vessels* from a double origine, some from the Womb, and some from the *Chorion*. The former are of four kinds, Arteries, Veins, Nerves and Lympheducts: all which though they be very large and conspicuous in the Womb, and are so even in that very place where the *Placenta* is joined to it; yet they send but the smallest Capillaries into the *Placenta* it self, and are dispersed onely through that side of it that is next the Womb. Those that come from the *Chorion* are Arteries and Veins, and Dr. *Wharton* supposes also Lympheducts. The Arteries and Veins that come from the Womb spring from the Hypogastricks, and also that branch of the *Spermaticks* that is inserted into the bottom of the Womb. Those that come from the *Chorion* are the Umbilical vessels of the *Fetus*. Of the use of both the one and other we shall speak in Chap. 33. when we come

to

to discourse how the *Fetus* is nourished, as also of the use of the *Placenta* it self, of which we shall onely observe this further here, That after it is joyned to the Womb, it sticks most firmly to it for the first months, as unripe Fruit do to the Tree: But as the *Fetus* becomes bigger, and riper and nearer to the birth, by so much the more easily will it part from the Womb; and at length, like to ripe Fruit, after the Child is born, it falls off from the Womb, and makes part of the After-birth.

It was an old tradition continued for many Acetabula hundred years, that the *Placenta* adheres to the Womb by certain parts called *Cotyledones*; or *Acetabula*. That there are such in some Creatures it is certain; Dr. Needham says they are onely properly so called in Sheep and Goats, in whom being with young the Uterine glands are hollow like a Saucer or an Acorn-cup, and are adapted to the little Prominences (or *Digituli*) of the *Placentulae* that grow on the *Chorion*, (though Diemerbroeck say, that on the contrary the *Placentulae* are hollow (and so are truly the *Acetabula*) and the Uterine glands protuberant) and doubts not but these names were first given by those that dissected these kind of Creatures, and were afterwards applied in following ages to other Animals. So that no wonder there have been so great contest even about the signification of the word *Cotyledon* (which is the Greek word for the herb *Umbilicus Veneris* or Navelwort) and what that was that was so called in the several Creatures that were said to have them. But because such Controversies are now obsolete, and that 'tis generally confessed that Women have them not, we shall not in this Epitome run out into

into needless Disputes; but only observe one singular opinion of *Diemerbroeck*, who ascribes *Coryledones* to Women. He thinks that each Woman (unless she go with Twins) has but one *Coryledon*, and that the foresaid *Placenta uterina* is it. And indeed it must be confest that it resembles much the shape of that from which the *Coryledones* have their name; and therefore seeing he formed this opinion to defend our great Master *Hippocrates*, who had ascribed them to Women, (that is, as *Diemerbroeck* expounds it, one *Coryledon* to one Woman) we shall not oppose it, but confess it to be, if not true, yet both ingenious and ingenuous.

C H A P. XXXII.

Of the Membranes involving the Fœtus, and of the humours contained in them.

NEXT to the *Placenta* follow the two *Membranes* that involve the whole *Fœtus*, *Chorion* the outer, and *Amnios* the inner: betwixt which two, after the *Fœtus* is perfectly formed, Dr. *Needham*, &c. affirms there is a third, viz. *Allantois*, which in Women likewise includes the whole *Fœtus* *. Of each of these in their order, with the *liquors* they contain.

* *Needh.*
de forma-
to fœtu p.
59.

Chorion.

The outmost *Membrane* is called *Chorion*; it is pretty thick, smooth on the inside, but without something unequal or rough, and in that part of it that adheres to the *Placenta* and by it to the Womb,

Womb, has very many Vessels which spring from the *Placenta* it self, and from the Umbilical vessels. Those which spring from the *Placenta* are dispersed through it before the *fetus* is shaped (as *Diemerbroeck* affirms;) but the latter not till the Navel-rope is grown out to a just length, at which time they enter it and intermix with the former, and from this membrane are inserted into the *Placenta* to which the *Chorion* adheres. It is but one even when the Mother goes with Twins: for as in a Nut that has two Kernels in it, they are both included within the same Shell, but are each invested in their proper Membrane; so Twins are both inclosed in one *Chorion*, but have each a particular *Amnios*. It invests the *Ovum* originally, which *Ovum* being brought into the Womb and becoming a Conception, this Membrane imbibes the moisture that bedews the Womb plentifully at that time. For whiles the Conception is loose in the Womb, and has no Vessels that reach out of it self, nor is fasten'd to any part, it must have its increase after the same manner as the Egg has in Hens, "which while it "is in the *racemus* or knot, consists of no other substance but Yelk; and when it drops off from "thence and descends through the *Infundibulum*, "it receives no alteration; but when it comes "into the Cells of the process of the *Uterus*, it "begins to gather a White, although it stick to "no part of the *Uterus* nor has any Umbilical "Vessel; but (says my Authour, the immortal " * *Harvey*) as the Eggs of Fishes and Frogs do "without, procure to themselves Whites out of "the water; or as Beans, Pease and other pulse, "and Bread-corn being steep'd in moisture swell, "and thence acquire aliment for the bud that is "spring-

* De gene-
rat. Ani-
mal. Ex-
ercit. 9. de
gene-
rat. Ovi.

"springing out of them: so in like manner out
 "of the *plica* or wrinkles of the Womb (as out
 "of a Dug or Womb-cake) does there an albu-
 "gineous moisture flow, whence the Yelk (by
 "that vegetative and innate heat, and faculty
 "wherewith it is endued) gathers and concocts its
 "White. And therefore in those *Plica* and the
 "hollow of the Womb does there plentifully a-
 "bound a liquor resembling the taste of the White.
 "And thus the Yelk descending by little and little
 "is encompassed with a White, till at last in the
 "outmost *Uterus* having assumed Membranes and
 "a Shell, it is perfected.] Thus I say does the
Chorion imbibe that albugineous liquor that from
 the first Conception, increases daily in it (and
 transudes through the *Amnios* wherein the *Embryo*
 swims) till the Umbilical vessels and the *Placenta*
 are formed, from and through which the *Fetus*
 may receive nourishment.

Its liquor.

This liquor that it imbibes I take to be nutriti-
 ous juice that ouzes out of the capillary orifices of
 the Hypogastrick and Spermatick arteries, and is
 of the same nature with that which afterwards is
 separated in the *Placenta* and carried to the *Fetus*
 by the Umbilical vein, and with that also which
 abounds in the *Amnios* even till the birth. For
 the plastick or vegetative virtue is onely in the
Ovum it self, and the augmentation that the first
 lineaments of the *Embryo* receive, is onely by ap-
 position of this nutritious albugineous juice. But
 this Membrane *Chorion* by that time the Umbili-
 cal Vessels and *Placenta* are formed, is grown so
 dense and compact, that it is not capable of im-
 bibing more; but that which at this time is in it,
 does in small time transude into the *Amnios*, and
 so it self becomes empty, and gives way to the
 en-

encrease of the *Allantoides*, (which thenceforward begins to appear) whose liquor augments daily as the *Fœtus* grows nearer and nearer to the birth. This is my conjecture, which I submit to the censure of the learned.

The *Amnios* is the inmost Membrane that immediately contains the *Fœtus*. It is not knit to the *Chorion* in any place save where the Umbilical vessels pass through them both into the *Placenta*. It is very thin, soft, smooth and pellucid, and encompasses the *Fœtus* very loosely. It has Vessels from the same origines as the *Chorion*. It is something of an oval shape. Amnios.

Before the *Ovum* be impregnated, this Membrane contains a limpid liquor, which after the impregnation is that out of which the *Embryo* is formed. In it resides the plastick power, and the matter also out of which the first lineaments of the *Embryo* are drawn. But because its liquor is so very little, there transfuses through this Membrane presently part of that nutritious albugineous humour that is contained in the *Chorion*, which it had imbibed out of the *Uterus*, as was but even now shewn. And by the juxta-apposition or addition of this humour to the undiscernible rudiments of the *Embryo*, it receives its encrease. But though the *Amnios* have its additional nutritious liquor at first onely by transudation; yet when the Umbilical vessels and the *Placenta* are formed, it receives it after another manner. For then this liquor being separated from the Mothers Arteries by the *Placenta* and imbibed by the Umbilical vein of the *Fœtus*, it passes directly to its heart, from whence being driven, a great part of it, down the *Aorta*, it is sent forth again Its liquor.

again by the Umbilical arteries, out of whose capillaries dispersed plentifully through the *Ammios* it issues into its Cavity, even as far more gross and viscid juices in taking a purge (or sometimes critically) ouze out of the small mouths of the Arteries that gape into the Intestins.

There are some that think they have observed *Vene lactea* to come directly to the *Placenta*, and that out of it (as out of the Glands in the Mesentery) there arise others that convey the Chyle into the *Ammios*: and this indeed were a plausible opinion, if it were grounded on any certain or frequent observation of such Lacteals, and were not rather invented to avoid some difficulties with which the former opinion seems to be pressed.

Allantoides.

A third *Membrane* which invests the whole *Fetus* (according to Dr Needham, &c.) is that called *Allantoides*, though improperly as to Women. For it is so called from its likeness to a Pudding (*ἀλλανξίς*, *Farcimen*) which indeed it does resemble in Sheep, Does, Hogs, &c. but in Women, as also in Mares, it has the same figure as the *Chorion* and *Ammios*, betwixt which it is placed in their whole circumference, (as the said learned Author affirms.) Now though it must be supposed that this as well as the other two, is originally in the *Ovum*, yet there is no appearance of it till after the Umbilical Vessels and *Placenta* are formed, and the albugineous liquor (so often mentioned) ceases to be imbibed by the *Chorion* out of the *Uterus*. But as soon as the *Fetus* begins to be nourished by the Umbilical vessels, and the *Urachus* is permeable, then presently this Membrane begins to shew it self,

self, containing a very thin liquor, which is the Urine of the *Fetus* brought into it by the *Urachus* from its Bladder; and with which it is filled daily more and more till the birth. It is very thin, smooth, soft and yet dense. It may be known from the *Chorion* and *Amnios* by this, that they have numerous Vessels dispersed through them, but this has not the least visible Vein or Artery. It is very hard to separate the *Chorion* from it, because when it appears, the *Chorion* becomes void of all liquor, and so claps close to it. But towards the birth of the *Fetus* it becomes so turgid with Urine, that the *Amnios* (immediately containing the *Fetus*) swims in it, and so may most easily be distinguished and separated from it.

The liquor that it contains is (as has been said) the Urine of the *Fetus* brought ^{its liquor.}hither by the *Urachus*. For as soon as the *Fetus* is perfectly formed, its Kidneys must needs perform their office of separating the *Serum* from the Blood, for otherwise it would be affected with an *Anasarca*, or other sort of Dropsie. I say the *Serum* is separated in the Kidneys and glides down from thence into the Bladder, in which it is found pretty plentiful when the *Fetus* is five or six months old. Now it flows not out of the Bladder by its neck, because at that time the Sphincter is too contracted and narrow, and if it should pass that way, it would mix with that nutritious juice in which the *Fetus* swims in the *Amnios*, and wherewith, by taking it in by its Mouth, it is partly nourished, and so would defile and corrupt it, and make it unfit for nourishment. Nature therefore has provided it another exit by the *Urachus* inserted into the bottom of the Bladder; which though after the Child is born it grow solid like a Ligament,

ment, like as the *Vena umbilicalis* does, yet while the *Fœtus* is in the Womb it is always pervious, and conveys the Urine into the *Allantoides* that is placed betwixt the *Chorion* and *Amnios*, where it is collected and preserved till the birth.

C H A P. XXXIII.

Of the Umbilical vessels, and of the nourishing of the Fœtus.

The Navel-string. **H**AVING opened the Membranes that enwrap the *Fœtus*, there appears the *Navel-string* or *Rope*, which is membranous, wreath'd and unequal, arising out of the middle of the *Abdomen*, (*viz.* the Navel) and reaching to the Womb-liver or *Placenta*, of a notable length, being three spans or half an Ell long, and as thick as ones finger. It was convenient to be so long and lax, that when the *Fœtus* in the Womb grows strong, it might not break it by its sprawling and tumbling about; and after it is born, the *Secundines* or After-birth might be drawn out the better by it.

Its situation. The way that it passes from the Navel to the *Placenta* is very unconstant; for sometimes it goes up on the right hand to the Neck, which having encompassed, it descends to the *Placenta*, and sometimes it goes on the left hand up to the Neck, &c. Sometimes it comes not to the Neck at all, but goes first a little up towards its Breast, and then turns round its Back, and from thence passes to the *Placenta*.

The

The *Vessels* contained in this string (and which *Vessels* are inwrapped in a common Coat called *Funiculus* or *Intestinulum*) are four, one Vein, two Arteries and the *Urachus*.

The *Vein* is larger than the Arteries, and arises from the Liver of the *Fetus*, (*viz.* out of its fissure) by the trunk of the *Vena portæ* (of which it seems to be but a branch) and from thence passing out of the Navel it runs along the *Funiculus* to the *Placenta*, into which it is implanted by innumerable roots; but in its passage it sends some little twigs into the *Amnios*.

The Ancients that thought the *Fetus* was nourished by the Mothers Blood onely, taught the sole use of this Vein to be, to carry Blood from the *Placenta* to it: and since it has been found out and believed that it is nourished also (if not onely) by Chyle or *Succus nutritius*, some have continued the same office to this Vein, and think that the Chyle is brought by Lacteal vessels arising out of the *Placenta*, as (they say) it was brought thither by the Mothers Lacteals. And indeed if any certain discovery had been made of these same *Lactea*, we should have imbraced this opinion as the most probable. But we are not to form hypotheses out of rational notions onely, but much rather from what appears to the Eyes of the Dissector. We do affirm therefore that the Umbilical vein serves for conveying to the *Fetus* the nutritious juice separated in the *Placenta* from the Mothers Arteries. How this separation is made, and how it is first of all turned into Blood, we shall consider by and by.

But together with this juice there returns so much of the Arterial blood (that comes from the *Fetus*) as is not spent upon the nourishment

of the *Placenta*, or of the *Chorion* and *Amnios*.

Besides this Vein which is common to all Creatures, there have been observed in Whelps (and may perhaps in others) two small Veins more that pass directly from the *Umbilicus* to the Mesentery, as the other great one does to the Liver; which may strengthen the opinion that the Chyle or *Succus nutritius* is brought to the *Fetus* by the Sanguinary Vein (or Veins) from the *Placenta*.

Arteries.

In the *Funiculus* are included also two *Arteries*, which are not both of them together so big as the Vein. They spring out of the inner Iliacal branches of the great Artery, and passing by the sides of the Bladder they rise up to the Navel, out of which they are conducted to the *Placenta* in the same common cover with the Vein and *Urachus*, with which they are twined and wreathed not unlike a Rope. I say they are inserted into the *Placenta*, and with the Vein make a most admirable net-like texture. Dr. *Harvey* says, the Vein is conspicuous a pretty while before these Arteries appear.

Their use.

Bloud and Vital spirit are not carried by them from the Mother to the *Fetus*, as many, from *Galen*, have taught; but on the contrary, Spirituous bloud is driven from the *Fetus*, by the beating of its Heart, to the *Placenta* and the Membranes for their refection and nourishment; from which what Bloud remains, circulates back again in the Umbilical vein together with the *Succus nutritius* afresh imbibed by its capillaries dispersed in the *Placenta*. But besides Arterial bloud, there flows out of the Navel by them part of the *Succus nutritius* that was imported by the Umbilical vein, namely that of it which is more crass and terrene, which

which by one circulation through the Heart (or it may be many) could not be changed into Blood: this part I say flows out by these Arteries, which by their branches that are dispersed through the *Amnios* disimbogue it by their little Mouths into it; for what use, shall be declared presently.

And here I shall transcribe a material objection with the answer to it, out of *Dimerbroeck*.

Obj. "How can these Vessels (Vein and Arteries) when they have grown from the belly of

"the *Fœtus* to that length as to reach the Mem-

"branes, penetrate and pass through them to the

"*Placenta*? *Answ.* This is done in the same

"manner as the roots of Herbs, Shrubs and Trees

"penetrate into the hard Ground, yea often into

"thick Planks, Walls and Stones, (which water

"cannot enter) and root themselves firmly in

"them. For just so the first sharp-pointed and

"most fine ends of the Umbilical vessels in-

"sinuate themselves by little and little into the

"pores of the Membranes (for the figuration of

"those pores are fitted for their entrance) and

"pass through them, and yet the liquors contain-

"ed in these Membranes cannot flow out by

"them: and when those Vessels inhering in

"the pores grow more out into length, by little

"and little the said pores are more and more

"widened, (according to the increase of the Vessels) and are inseparably united unto and grow

"in them.

How the vessels pass through the Membranes.

The fourth Umbilical vessel is the *Urachus* or *Urachus*.

Urinary vessel. This is a small, membranous,

round Pipe, endued with a very strait Cavity,

arising from the bottom of the Bladder up to the

Navel, out of which it passes along within the

common cover, and opens into the *Allantoides*. It is more apparently pervious in many of the larger Brutes than it is in Man, in whom some have denied it any Cavity : but that it is hollow in him, is confirmed by many Histories of persons adult, who having the ordinary urinary passage along the *Penis* stop'd, the passage in this Vessel has been unlocked, and they have made water by the Navel, which could not have been imagin'd to have happen'd, if it had been originally a Ligament without any *Meatus*. *Bartholin* and others have affirmed that the *Urachus* in Men reaches no further than the Navel ; How then comes that humour into the *Allantoides* that has perfectly the same taste with the Urine in the Bladder ? But their error sprung from hence, that they thought an humane *Fetus* had no *Allantoides*, and that humour that is found in it, they thought had been contained in the *Chorion*. But this is in short refuted above, but more fully and accurately by Dr. *Needham*, *lib. de formato Fetu*, *cap. 3.* As to the perviousness of the *Urachus* I shall add this further, that in abortions of five or six months old, the Bladder of the *Embryo* is always full of Urine, out of which if in the following months it should not be emptied by the *Urachus*, the Bladder would soon burst, seeing there is daily some *Serum* separated from the Bloud in the Kidneys, and sent to the Bladder ; and the more the *Fetus* increases, the more must needs be separated. Yea Dr. *Needham* affirms that one may either press the liquor contained in the *Allantoides* by the *Urachus* into the Bladder, or with a pipe blow wind out of the Bladder by the same way into the *Allantoides*.

Its use has been sufficiently declared in the preceding Paragraph; as also above, when we delivered the use of the *Allantoides*, which we shall not repeat. Its use.

These four Vessels (as has been said above) have one common cover, which also keeps each of them from touching other. It is called *Intestinulum*, and *Funiculus* (by which it with its Vessels is sometimes understood.) It is membranous, round and hollow, indifferent thick, consisting of a double coat, (the inner from the *Peritonæum*, and the outer from the *Panniculus carnosus*.) Sometimes it self onely is wreath'd about like a Rope, the Vessels included in it running streight along its Cavity; and sometimes they are wreathed together with it. Funiculus.

It has several knots upon it here and there, which Dr. Wharton thinks to be *Papillæ* or little Glands through which the lacteal (or nutritious juice) distils out of the capacity of the *Funiculus* into the Cavity of the *Amnios*. I cannot tell whether this be so or no, but that use that doting Midwives make of them, to guess by their number how many Children more the Mother shall have, and by their colour, whether those Children shall be Male or Female, is most ridiculous and superstitious. Its knots.

When the Infant is born, this Navel-rope is used to be tied, about one or two fingers breadth from the Navel, with a strong thread cast about it several times, and then about two or three fingers breadth beyond the Ligature to be cut off. What is not cut off, is suffered to remain till it drop off of its own accord. Which the longer or shorter How to tie the navel-string and cut it off.

shorter while it is a doing, the longer or shorter-liv'd, Women prophesie the Children will be.

Of the nutrition of the Fœtus.

There have been great disputes among both Philosophers and Physicians, with what, and by what way the *Fœtus* is nourished. Some affirm by Blood onely, and that received by the Umbilical vein; others by Chyle onely, received in by the Mouth: each of which are in an extream. The truth is, according to the different degrees of perfection that an *Ovum* passes from a Conception to a *Fœtus* ready for the birth, it is nourished diversly.

First, by apposition.

For first, as soon as an *Ovum* impregnated is descended into the Womb, it presently imbibes through its outer Membrane some of that albuginous liquor that at this time plentifully bedews the internal superficies of the *Uterus*; so that as soon as the first lineaments of an *Embryo* begin to be drawn out of that humour contained in the *Amnios*, they presently receive increase by the apposition of the said liquor filtrated out of the *Chorion* through the *Amnios* into its Cavity. And this same liquor that thus encreaseth the first rudiments of the *Embryo* is called by Dr. Harvey *Colliquamentum*. That this way of nutrition or augmentation of the *Embryo* is possible, need not be doubted by him that considers that the *Fœtus* of a Sow have no other possible way of being nourished till she is near gone half with Pig; "for even till then, saith Dr. Needham, the *Chorion* cleaves not to the Womb, but look as many *Fœtus* as there are, there are so many Eggs as it were without Shells, neither sticking to the Womb nor to one another; but when one opens the Matrix, they all tumble out of their own

own accord. There are no Glandules, no *Placenta*. But the *Chorion* which is soft and porous, does like a Sponge imbibe or suck up the ferous liquor that sweats out of the inmost Membrane of the *Uterus*, to be afterwards swallowed by the Veins, (I suppose he means the mouths of the Umbilical vein, after the said Vein is so perfectly formed as to receive it.) But of this more in the beginning of the foregoing Chapter.

But when the parts of the *Embryo* begin to be a little more perfect, and the *Chorion* becomes so dense that not any more of the said liquor is imbibed by it, the Umbilical vessels begin to be formed, and to extend to the side of the *Amnios*, which they penetrate, and both the Vein and Arteries pass also through the *Allantoides* and *Chorion*, and are implanted into the *Placenta*, that at this time, first gathering upon the *Chorion*, joins it to the *Uterus*. And now the Hypogastrick and Spermatick arteries, that before spued out the nutritious juice into the Cavity of the *Uterus*, open by their orifices into the *Placenta*, where (whether by meer percolation through it, or by some sort of fermentation also, I will not determine, but) they deposite the said juice, which is absorbed by the Umbilical vein, and by it conveyed first to the Liver, then to the Heart of the *Fetus*, where the thinner and more spirituous part of it is turned into Bloud. But the more gross and terrene part of it descending by the *Aorta* enters the Umbilical arteries, and by those branches of them that run through the *Amnios*, is discharged into its Cavity. They that will laugh at this passage of the nutritious juice because it is made by this doctrine to choose its way, as if it were some animal or even rational Creature, let

2. By the
umbilical
vein.

them avoid the like treatment if they can while they deliver that the Chyle passes immediately either from the Mesentery, the *Receptaculum* or *Ductus communis* to the *Placenta*, when a *Fœtus* is in the Womb. Pray how should the Chyle know, or the Lacteals, by which it passes, that there is any *Fœtus* in the Womb, that the one should offer to go that way, and the other give it way to go thither at that time, whereas the passage is shut at all other times? yet this my Opponents maintain. As also how comes the Chyle presently to turn its course after the *Fœtus* is born, and instead of descending to the *Uterus*, ascend to the Breasts? What mechanical cause can be assigned to these and many other the like *Phænomena*? We must therefore be content to resolve some things into the admirable and unintelligible disposal of our wise Creator.

But there lies another objection against this opinion, Because it allows none of the Mothers Blood to be received by the *Fœtus* through the Umbilical vein, but onely *Succus nutritius*; how should Blood be first bred in the *Fœtus*, seeing it has Blood, before the Liver or Heart, or any other part that conduce to sanguification, are in a capacity to perform their office?

I confess it is inexplicable by me how Blood should be made so soon; but that it may be and is made, out of the *Succus nutritius* or *Colliquamentum*, without the mixture of any from the Mother, is apparent from the most accurate observations of Dr. Harvey concerning the order of the generation of the parts in a Chicken, (which from first to last receives nothing from the Hen.) Says he, * "there appears at the
 "very

*De generat.
 rat. Animal.
 exercit.
 cit. 51.

“very first a red leaping *Punctum* or Speck, a
 “beating Bladder, and Fibres drawn from thence
 “containing Blood in them. And as much as
 “one can discern by accurate inspection, blood is
 “made, before the leaping speck is formed; and
 “the same is endued with vital heat, before it is
 “stirred by the Pulse: and as the pulsation be-
 “gins in the blood and from it; so at length, at
 “the point of death it ends in it. ——— And be-
 “cause the beating Bladder and the sanguineous
 “Fibres that are produced from it, appear first
 “of all; I should think it consentaneous to rea-
 “son, that the blood be before its receptacles;
 “namely the content before its container; and
 “that this is made for the sake of the other.
 He confesses it to be a *paradox*, that blood should
 be made and moved, and endued with vital spirit
 before any sanguifying or motive organs are in
 being; and that the Body should be nourished and
 increased, before the organs appointed for con-
 coction (namely the Stomach and Bowels) are
 formed: but neither of these are greater para-
 doxes than that there should be sense and motion
 in the *Fœtus* before the Brain is composed; and
 yet, says he, * “the *Fœtus* moves, contracts and * *Exercit.*
 “stretches out it self, when there is nothing con- 57.
 “spicuous for a Brain but clear water. I say if
 all these unlikely things do certainly come to pass
 in an Egg, that has nothing to set the vegetative,
 or vital principle thereof on work, but the
 warmth of the Hen that sits upon it; why should
 we think it strange that nutritious juice impreg-
 nated with the vital spirits of the Arterial blood,
 with which it circulated through the Mothers
 Heart (it may be more than once) should be
 turned into blood in an humane *Fœtus* (fostered
 with

with such kindly warmth in the Womb) though it neither receive any humour under the form of bloud from the Mother, nor have it self as yet any organs of sanguification so perfect as to perform their office? But to proceed.

3. By the Mouth.

The grosser nutritious juice being deposited by the Umbilical arteries in the *Amnios*, as soon as the Mouth, Gullet and Stomach, &c. are formed so perfectly that the *Fetus* can swallow, it sucks in some of the said juice, which descending into the Stomach and Intestins is received by the *Vena lactea*, as in adult persons.

That the *Fetus* is nourished this way, *Diemerbroeck* evinces by these reasons.

“ 1. Because the Stomach of the *Fetus* is never empty, but is found possess’d of a milky whitish liquor; and such like is contained even in its Mouth.

“ 2. Because there are *Fæces* contained in the Intestins, (which Philosophers call *Meconium*) which the Infant as soon as ’tis born voids by stool. Without doubt these are the excrements of some aliment taken in by the Mouth.

“ 3. Because the Stomach could not presently after the birth perform the function of concoction, if it had not at all been accustomed to it in the Womb.

His fourth reason, supposing the *Fetus* to be nourished in part by the Mothers blood, I shall not recite, because I think that to be an erroneous opinion, as I think to make appear by and by.

“ 5. Because the Infant as soon as it is born knows how to suck the Breast, which it could not be supposed to be so dextrous at, if while it remained in the Womb it had taken nothing by suction.

“ 6. Be

“6. Because many Infants as soon as they are born, before they have sucked any Breast, or taken any thing by the Mouth, vomit up a milky aliment : which therefore must needs be received into their Stomach in the Womb. This he gives an instance of in one of his own Children.

These Arguments I think sufficient to prove what they are alledged for ; but when he would afterwards prove that the *Fœtus* is also nourished by the Mothers blood conveyed by the Umbilical vein, I think his reasons are invalid. For he says it must be so, *first*, because the said Vein is implanted into the *Placenta* ; (but this is but begging the question, for 'tis necessary it should be implanted into it though it receive nothing from it but nutritious juice.) *Secondly*, because of the great quantity of blood that will issue out of the Umbilical vein, if one tie the Navel-rope and then open the said Vein betwixt the Ligature and *Placenta* : for he says there will flow out four times as much blood as could be supposed to be contained in the small Arteries on that side the Ligature next the *Placenta*. I answer, that first one would be well satisfied that the Ligature was made so strait, that there could no blood pass through it from the *Fœtus* to the *Placenta*. And secondly it cannot exactly be guessed how much blood may be contained in the *Fœtus's* Arteries in the *Placenta*, so as that one should be certain that there does four times more flow out by the Vein. But lastly, suppose there do four times as much more blood issue out of the Vein as is contained in the *Fœtus's* Arteries that are on that side the Ligature next the *Placenta*, and this blood come from the Dam's Hypogastrick and Spermatick arte-

The Fœtus is not nourished at all by the Mothers blood.

arteries; I say there will not onely four times, but forty times as much issue therefrom, for all the blood of the Dam might then be drawn out this way. Wherefore I think this experiment makes much more against his opinion than for it. His *third* reason is the necessity of it; because as the *Fetus* increaseth, it needs much aliment, and its weak Bowels can concoct but little, it must therefore have some purer aliment, and which is already concocted (he means blood) to nourish it, and by its commixture to help forward the changing the aliment received by the Mouth into blood. *Ans.* This reason himself invalidates in the next Paragraph, * where he confesses that the *Fetus* in the Womb is nourished in the same manner as the Chicken in an Egg, which receives increase first by the *inner* White (as he distinguishes) by way of apposition; secondly it receives nourishment in by the Mouth from the *outer* White, and at the same time its Umbilical vessels enter the Yelk (to draw nourishment from thence) which, he says indeed, resembles the Mothers blood, but seeing it has not the least form of blood, why would it not be more plausibly said that it is instead of the *Succus nutritius* that the *Fetus* in viviparous Animals receives by the Navel-vein? And seeing these several liquors are turned, part of them, into blood in a Chicken, without any of the Hens blood to *ferment* them (as he speaks;) why should not the same power be granted to the vegetative or animal soul of the *Fetus* in the Womb, without any assistance from the Mothers blood? To which I shall add another Argument (out of Dr. *Harvey*) taken from Cæsarean births, when living Infants are cut out of the Mothers Womb, after she is dead.

* Anat.
corp.
hum.
p. 367.

dead. For if it had its life and heat from the Mothers blood; surely it should die as soon as she at least, if not sooner: for when death approaches, the subordinate parts do languish and grow cold before the principal; and therefore the Heart fails last of all. Wherefore the blood of the *Fœtus* would first lose its heat, and become unfit for its office if it were derived from the Mothers Womb; seeing her Womb is destitute of all vital heat, before her Heart. But enough of this.

But some may object, if the *Fœtus* be nourished by none of the Mothers blood, why should her *Menses* be stopt all or most of the while she is with Child? To which I answer, that 'tis for the same reason that Nurses that give suck commonly want them also; for as in Nurses the chyle passes in a great proportion to the Breasts, whereby the blood being defrauded of its due and wonted share does not increase to that degree as to need to be lessened by the flowing of the *Menses*; so in Women with Child, there is so great a quantity of the *Succus nutritivus* (which is onely chyle a little refined and impregnated with vital spirit) that passes to the *Placenta* by the Hypogastrick and Spermatick arteries for the nourishment of the *Fœtus*, that unless the Mother be very sanguine, her *Menses* intermit after the first or second month.

The reason why Women with child want their Menses.

I shall conclude therefore, that the *Fœtus* is nourished three several ways, but onely by one humour: first by apposition of it while it is yet an imperfect *Embryo* and has not the Umbilical vessels formed; but after these are perfected, it then receives the same nutritious juice by the Umbilical vein, the more spirituous and thin part where

whereof it transmutes into bloud, and sends forth the grosser part by the Umbilical artery into the *Ammios*, which the *Fætus* sucks in at its Mouth, and undergoing a new concoction in its Stomach is received out of the Intestins by the *Vena lactea*, as is done after the birth.

C H A P. XXXIV.

What parts of a Fætus in the Womb differ from those of an adult person.

HAVING delivered the history of the *Fætus*, we will onely further shew in what Parts a *Fætus* in the womb differs from an adult person. And this we cannot do more exactly than in the manner that *Diemerbroeck* has reckon'd them, whom therefore we shall here translate, with little alteration.

This diversity, he saith, consists in the difference of magnitude, figure, situation, number, use, colour, cavity, hardness, motion, excrements and strength of the Parts.

Now this diversity is conspicuous either in the whole Body, or in the several Ventricles, or in the Limbs.

There is considerable in the whole Body,

1. The littleness of all the parts.
2. The reddish colour of the whole.
3. The softness of the Bones; whereof many are as yet gristly and flexible, and that by so much the more, by how much the *Fætus* is further from maturity.

In

Ch. XXXIV. *Wherein a Foetus differs from a Man.* 223

In the Head there are several differences. As

1. The Head in respect to the proportion of the rest of the Body is bigger, and the shape of the Face less neat.

2. The bones of the Scull are softer, and the Crown is not covered with bone, but onely with a Membrane.

3. The bone of the Forehead is divided, as also of the under-Jaw: and the *Os cuneiforme* is divided into four.

4. The bone of the Occiput or hinder part of the Head is distinguisht into three, four or five bones.

5. The Brain is softer and more fluid, and the Nerves very soft.

6. The bones that serve the sense of Hearing are wonderfully hard and big.

7. The Teeth lie hid in the little holes of the Jaw-bone.

There is no less diversity in the *Thorax*. For,

1. The Dugs swell, and out of them in Infants new-born whether Male or Female, a serous Milk issues forth sometimes of its own accord, sometimes with a light pressure: yet there are no Glandules very conspicuous, but there is some fashion of a Nipple.

2. The *Vertebrae* of the Back want their spinous processes, and are each one made of three distinct Bones, whose mutual concourse form that hole whereby the spinal marrow descends.

3. The Heart is remarkably big, and its *Auriculae* large.

4. There are two unions of the greater Vessels, that are not conspicuous in adult persons: viz.

1. The *Foramen ovale*, by which there is a passage open out of the *Cava* into the *Vena pulmona*

ris just as each of them are opening the first into the right Ventricle, and the latter into the left Ventricle of the Heart. And this *Foramen* just as it opens into the *Vena pulmonaris* has a Valve that hinders any thing from returning out of the said Vein into the *Foramen*. 2. The *Canalis arteriosus*, which two fingers breadth from the *basis* of the Heart joins the *Arteria pulmonaris* to the *Aorta*. It has a pretty large Cavity, and ascends a little obliquely from the said Artery to the *Aorta*, into which it conveys the blood that was driven into the pulmonary Artery out of the right Ventricle of the Heart, so that it never comes in the left Ventricle; even as that blood that is sent out of the left Ventricle into the *Aorta* never came in the right, (except a little that is returned from the nutrition of the Lungs) but passed immediately into it out of the *Vena cava* by the *Foramen ovale*. So that the blood passes not through both the Ventricles as it does after the *Fetus* is born, for then it must have had its course through the Lungs, which it cannot have, because they are now very dense and lie idle and unmoved. Yea they are so dense and heavy that if one throw them into water they will sink, whereas if the *Fetus* be but born and take onely half a dozen breaths, they become so spongy and light that they will swim. Which (by the way) may be of good use to discover whether those Infants that are killed by Whores, and which they commonly affirm were still-born, were really so or no. For if they were still-born the Lungs will sink, but if alive, (so as to breath never so little a while) they will swim.

5. The Gland *Thymus* is notably large, and consists as it were of three Glands.

In

Ch. XXXIV. *Wherein a Fœtus differs from a Man.* 225

In the lower belly there are these differences.

1. The Umbilical vessels go out of the *Abdomen*.

2. The Stomach is narrower, yet not empty, but pretty full of a whitish liquor.

3. The Caul is hardly discernible, being almost like a Spiders web.

4. The Guts are seven times longer (or more) than the Body;

5. In the small Guts the excrements are pituitous and yellow, but in the thick somewhat hard and blackish, sometimes greenish: the *Cæcum* is larger than usual, and often filled with *Fæces*.

6. The Liver is very large, filling not onely the right Hypochondre, but extends it self into the left side, and covers all the upper part of the Stomach. It has a passage now more than in the adult called *Canalis venosus*, which arising out of the *Sinus* of the *Porta* carries the greatest part of what is brought by the Umbilical vein directly and in a full stream into the *Cava* above the Liver; but as soon as the Infant is born, and nothing comes any longer by the said Vein, this *Canalis* presently closes, as the Vein it self turns to a Ligament; as also do the *Urachus* and the two Umbilical arteries.

7. The Spleen is small.

8. The Gall-bladder is full of yellow or green choler.

9. The Sweet-bread is very large and white.

10. The Kidneys are bigger and unequal in their superficies, and look as if they were compounded of a collection of very many Glandules.

11. The *Renes succenturiati* are exceeding large; they do not onely border upon the Kidneys, as in the adult, but lie upon them, and

Q

embrace

embrace their upper part with a large *Simus* as it were.

12. The Ureters are wide, and the Bladder distended with Urine.

13. In Females the *Uterus* is depressed, the *Tubæ* long, and the *Testes* very large.

The difference in the Limbs consists

1. In the tenderness and softness of the Bones.
2. The little bones of the Wrist and Instep are gristly and not firmly joyned together.

C H A P. XXXV.

Of the Birth.

THE *Fætus* swimming in the liquor of the *Amnios*, and the Navel-rope being so long, it must needs have scope enough to change its situation, and that is the reason that Anatomists differ so much about it. But according to Doctor *Harvey* its usual posture is thus:

The posture of the *Fætus* in the Womb.

“ Its Knees are drawn up to the Belly, its Legs bending backwards, its Feet across, and its hands lifted up to its Head, one of which it holds to the Temple or Ear, the other to the Cheek; where there are white spots on the Skin as if it had been rubb’d upon. The Backbone turns round, the Head hanging down towards its Knees. Its Head is upwards and its Face commonly towards the Mothers Back.]

At its birth.

But towards the birth (sometimes a week or two before) it alters its situation, and tumbles down

down with its Head to the neck of the Womb, with its Feet upwards. Then the Womb also settles downwards and its orifice relaxes and opens. And the *Fetus* being now ill at ease sprawls and moves it self this way and that way, whereby it tears the Membranes wherein it is included, so that the Waters (as they call them) flow into the *Vagina*, which they make slippery for the easier egress of the Infant: though sometimes the Membranes burst not but come forth whole, (as they do commonly in Brutes.) At the same time the neighbouring parts are loosened and become fit for distention: the joyntings of the *Os sacrum* and *Pecten* with the *Coxendix*, as also of the *Ossa pubis* are so relaxed, that they yield very much to the passage of the *Fetus*. And its motion gives that disturbance to the *Uterus*, that presently the animal spirits are sent plentifully by the Nerves to its constrictory Fibres, and the Muscles of the *Abdomen*, which all contracting together, very strongly expell the *Fetus*, which (in the most natural birth) goes with the Head foremost: and if the Feet or any other part (besides the Head) do offer it self first, the travail is always more painfull and dangerous.

The several sorts of Creatures have sundry The term of going with child. terms of going with young: The stated and most usual time of Women is nine months; though some bring forth some weeks sooner and others later. But when it is given out that perfect and sprightly Infants are born at seven months end; it is either to hide the faults of some new-married Woman, or from the mistake of the ignorant Mother. As also when sometimes the Mother has affirmed her self to go eleven months or upwards, it is either through mistake, or to keep

fast some fair Estate, when the pretended Father's dead without an Heir, for which the cunning Widow plays an after-game.

*The reason
of the
birth.*

Dive reasons are given why the *Fetus* at the stated time of birth is impatient of staying any longer in the Womb. As the narrowness of the place, the corruption of its aliment or the defect of it, the too great redundance of excrements in the *Fetus*, and the necessity of ventilation or breathing. All these are plausibly defended by their several Authors. But without blaming ingenious Men for exercising their wits on such a Subject, we choose however rather to be content with resolving all into the wise disposal of the great Creatour, whose power and wisdom were not more eminent in creating Man at first out of the Dust of the Earth, than out of those principles and in that method whereby he is produced in ordinary generation.

Tab. X.

Fig. 1. Representeth the usual situation of the *Fetus* in the Womb.

A Its Head hanging down forwards, that its Nose may be hid betwixt its Knees.

BB Its Buttocks, to which its Heels close.

CC Its Arms.

D The Umbilical rope passing by its Neck, and wound round over its Forehead.

Fig. 2.



Fig. 1.

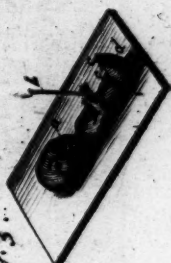


Fig. 2. Sheweth the *Fœtus* taken out of the Womb and as yet tied to the *Placenta*, the Umbilical vessels being separated at their rise.

AAA *The Abdomen opened.*

B *The Liver of the Fœtus.*

C *The Urinary bladder.*

DD *The Intestins.*

E *The Umbilical Vein.*

FF *The Umbilical Arteries.*

G *The Urachus.*

H *The Umbilical vessels united and invested in their common Coat.*

I *The Funiculus umbilicalis reaching to the Placenta.*

KKKK *The Veins and Arteries dispersed through the Placenta.*

LLL *The Placenta of the Womb.*

Fig. 3. Sheweth an *Embryo* in its just dimension, (communicated to me by Dr. E. Tyson.)

a *Its wide mouth with the tongue in it.*

b *The Umbilical rope.*

c *The Thighs and Legs, with the Coccyx appearing like a Tail.*

The end of the First Book.

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*The Second Book.*OF THE
MIDDLE CAVITY,

CALLED

THORAX.

CHAP. I.

*Of the common containing parts of the Thorax
or Breast.*

Hitherto of the Lowest Cavity or *Abdomen*, The
and of the parts contained in it, whe- *Breast*.
ther appointed for *Chylification* (and in
some respect for *Sanguification*) or for *Procreation*:
Now it followeth that we describe the middle
Cavity, called *Thorax*, which containeth the Or-
gans of *Respiration*, and those that elaborate the
Bloud and *Vital spirits*, with the trunks of the
Vessels whereby these are distributed into all the
parts of the Body, for their refection, and the pre-
servation of their natural heat.

Its bounds. This Cavity is bounded above by the *Claviculae* or *Chanel-bones*, below by the *Diaphragm* or *Midriff* (whereby it is severed from the *Abdomen*;) in the fore-part by the *Breast-bone* and *Cartilages*; in the Sides by the *Ribs*; behind by the *vertebrae* of the *Back*.

Figure. The figure of it is in a manner oval, somewhat flat before and behind, whereas in *Beasts* it is somewhat sharp: So that onely *Man* lieth on his *Back*.

Parts. The parts whereof it is composed, are either containing, or contained. The parts containing are either common, or proper.

The common containing parts. The common containing parts are in number five, viz. *Cuticula*, *Cutis*, *Pinguedo*, *Membrana carnosae*, and the common membrane of the *Muscles*. Of which having at large discoursed in *Book I. Ch. 3.* when we treated of the common containing parts of the *Lower Belly*, we shall not here repeat what is there delivered, but pass on to the proper.

C H A P. II.

Of the proper containing parts; and first, of the Dugs.

The proper containing parts. THE proper containing parts are either external, or internal. The external are in number three, the *Dugs*, the *Muscles*, and the *Bones*. The internal proper containing parts are three in like manner; the *Pleura*, the *Mediastinum*, and the *Diaphragm*.

The Paps. *Dugs* are granted to both *Sexes*, and are seated

in the middle of the *Thorax*, on each side one, upon the pectoral Muscle that draweth the Shoulder forwards.

In Men they are framed of the *Cutis*, the *Membrana carnosæ*, Fat, and the Nipple, and serve only for beauty, and are called *Mammillæ*. 1. Of Men.

In Women, besides these parts, they have remarkable Vessels, Glandules, and Pipes to contain the Milk separated by the Glandules, and are called *Mammæ*. 2. Of Women.

They differ much as to their bigness in several Women, and in the same Woman in regard of age and other circumstances: for before they have their *Menses*, and when they are very old, they bunch out but very little. And in the middle or flower of their age, when they give suck or are with Child, they are bigger than at other times. Their bigness.

They are made up of many glandulous bodies of a different bigness, and are not of one continued glandulous substance (as Dr. *Wharton* affirmeth, *lib. de Gland. p. 236.*) There is one Gland in the middle just under the Nipple that is bigger than the rest. The spaces between the Glands are filled up with fat, and there are abundance of Vessels that go from one to another. They are all inclosed by the *Membrana carnosæ*, and make up as it were an half globe. They are whiter of substance in Women than in Brutes. Through these Glands the Milk is separated from the Blood, being nothing but the Chyle issuing out of the left Ventricle of the Heart with the Blood (to which it is not as yet assimilated) and driven hither along the Thoracick arteries. Unless we will admit *Vena lacteæ* to come hither, which opinion we shall examine afterwards. Glands.

Upon the middle great Gland standeth the Papilla.

Papilla

Papilla or Nipple, which is round and of a spongy substance, covered with a very thin Skin, and has many little holes in it for the Milk to distil out by when the Child sucketh it. It is of an exquisite sense, and resembles something the *Glans* of a Man's *Penis*, in that by handling or sucking, it becomes erect or stiff, being otherwise commonly flaggy. It is red in Virgins, livid in those that give suck, and blackish in old Women. All the *Tubuli lactiferi* or Milk-conduits end in it.

Its bigness. It differs in *bigness*, being as big in some as a Mulberry, in other as a Raspberry, in others less: when Women give suck, it is longer than at other times.

Use. Its *use* is, to be like a Pipe or Tunnel, through which the Child (taking it in its Mouth) may suck the Milk out of the Breast: And it is of so exquisite sense that the Milk passing through it may cause a kind of titillation, whereby Mothers and Nurses may take the greater delight and pleasure to suckle their Infants.

Arcola. There is a little circle that surrounds it called *Arcola*, which in Virgins is pale and knotty; in those that are with Child or give suck, brown; and in old Women, black.

Their vessels. The Breasts have all sorts of Vessels, Veins, Arteries, Nerves, Lympheducts, which are common to them with other parts; and *Tubuli lactiferi* proper to themselves, and, according to some, *Vena Lactea*. Of all these in order.

Veins. The *Veins* are of two sorts, for some are *external*, some *internal*. The *external* spring from the *Axillar* branch, and run onely under the Skin which covereth the Breasts, and are called *Thoracicae superiores*, or the uppermost Breast-veins. And these are they that look so blue in the Breasts.

of

of fine-skin'd Women. The *internal*, called *Mammariæ*, spring from the *Rami subclavii*: They are in number two, on each side one. These enter in among the Glands of the *Mammæ*, where they send forth a great many branches; but descending thence by the *Mucronata cartilago*, they pass out of the Breast, and go downward under the *Musculi Recti*. When they are come to the umbilical region almost, they are said to be joyned by fundry inosculation with the *Venæ epigastricæ*, which meet them there; though most late Anatomists deny any such inosculation.

These *Venæ epigastricæ* spring from the external *Ramus iliacus*, and by a streight way pass upward under the aforesaid Muscles. And from the internal branch of the said *Ramus* spring the *Venæ hypogastricæ*, which are inserted into the neck and bottom of the Matrix. Of which in Book I. when we treated of the Womb.

They have the same number of *Arteries* as *Arteries*. Veins, and of the same denomination, viz. *Arteriæ thoracicæ superiores* which are sent forth from the Axillar, and *Arteriæ mammariæ* in like manner which spring from the Subclavian, and from the Breasts descend to about the Navel. Whither when they are come, they are said (but erroneously) to be united by inosculation with the *Arteriæ Epigastricæ* ascending. This inosculation being rejected, principally, because it is opposite to the circulation of the blood, seeing the blood in the descending Arteries runs a course direct contrary to that which is contained in the ascending; Dr. *Higmore* suggests "that the Mammary Arteries do not inosculate with the Epigastrick Arteries, but with the Epigastrick Veins, and accordingly the Mammary Veins with the Epigastrick

" epigastrick Arteries: Whence supposing (according
 " to the old opinion) that Milk is made of blood,
 " he thinks he has found a ready way whereby
 " the blood may pass to the Womb in pregnant
 " Women for the nourishment of the *Fœtus*, and
 " whereby it may ascend to the Breasts in Nurses.
 " For by the Epigastrick Arteries, he says, blood is
 " derived from the Iliack branches, and conse-
 " quently from the Womb, to the Mammary
 " Veins, so that that blood which in those that
 " do not give suck, or are not with Child, uses
 " to stagnate about the vessels of the Womb or
 " to be evacuated by the *Menses*, does in those
 " that give suck ascend by the Epigastrick arte-
 " ries to the Breasts, which it causes to swell, and
 " is turned into Milk: And on the contrary,
 " when the Child is weaned, that Blood which
 " used to be carried to the Breasts by the Mam-
 " mary and Epigastrick Arteries, is conveyed to
 " the Womb and evacuated monthly.] And for
 the confirmation of his opinion, in his Tab. 17.
 he gives a scheme of such inosculation, as if he
 had really observed it in his tracing these Vessels.
 But not to mention, that it is contrary to truth,
 that Milk is made of Blood; later Anatomists
 have wholly rejected any anastomosis of either
 sort, whether of Veins and Arteries with one a-
 nother, or with those of their own kind; so that
 his hypothesis which is built thereupon, falls to
 the ground. As for the true use of both Veins
 and Arteries, that shall be shewn by and by
 when we come to the use of the Breasts.

Nerves.

They have *Nerves* (according to *Spigelius*)
 from the fourth Intercoastal nerve springing out
 of the vertebral marrow of the *Thorax*, which
 about the middle of the Rib, perforating the In-
 tercoastal

tercostal Muscle, is divided into four branches, which are sent afterward to the pectoral Muscle, and so into the Breasts, the thickest passing to the Nipple.

They have very many *Lympheducts*. Doctor *Wharton* saith they are very conspicuous and numerous in the *Ubers* of Cows, but one can hardly trace them into the *Parenchyma*. Wherefore (saith he) 'tis likely that they carry back all the exhalations resolved into sweat by help of the Membranes—which they rather minister to than to the *Parenchyma*. *Lympheducts.*

Besides these four sorts of Vessels that are common to them with most other parts of the Body; they have proper to themselves certain *lactiferous* (or milk-carrying) *Pipes*, which are the Store-houses wherein the Milk is reserved, and through which as by Conduits it flows to the Nipple when the Child sucks. *Bartholin* has observed ten or more of them, full of Milk in Women giving suck, with their outer ends encompassing the *Papilla* circular-wise, each of which as they pass further into the Breasts, are divided into sundry branches, which end in the Mammary glands (above spoken of) from whence they bring the Milk, and discharge it through the pores of the *Papilla*. *Tubuli lactiferi.*

The several branches of these *Tubuli* amongst the Glands many do take for true Lacteals, and therefore do believe that there are some *Venæ lacteæ* that conduct the Chyle directly to the *Mammae*. But from whence those Lacteals have their origine, is not agreed among the defenders of that opinion. Some affirm them to rise from the Stomach, some from the *Pancreas*, and some from the *Ductus thoracicus*. The truth is, it is no wonder

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der they should not agree concerning their rise, seeing the opinion is grounded more upon rational conjecture, than ocular discovery. For as was said in the former Book (Chap. 32.) discouraging of the *Venæ lacteæ* their being said to convey the liquor into the *Amnios*, That that were a plausible opinion, if such could be demonstrated by Anatomy; so we may say as to their conveying the Chyle to the Breasts, where it comes to be called Milk. But with all due respect and deference to the Espousers of this Hypothesis (such as the most learned Sir George Ent, Caspar Martinus, Diemerbroeck, &c.) we must crave leave to dissent therefrom (with Dr. Wharton, Dr. Needham, &c.) till there shall be observed more certain footsteps of such Vessels.

The use of
the Mam-
mæ.

The use of the Breasts in Women is to prepare or separate Milk for the nourishment of the Child. Which how it is done, we shall shew in as few words as may be.

It was an old opinion that Milk was made of Blood sent from the Womb by the Epigastrick vessels ascending, and as was thought insculcating with those branches of the *Mammariæ* that descend towards the Navel. But as later Anatomists have found those anastomoses onely imaginary (invented to serve an Hypothesis;) so it is generally denied that either Blood sent from the Womb, or from wheresoever, is the true matter out of which Milk is made. For not to mention (which yet is very considerable) that it is incredible that the Mother could every day endure the loss of so much Blood (suppose a pound and half) as the Child sucks daily Milk from the Breasts; I think the argument urged by Dr. Wharton may satisfy any Man. *Viz.* "Nature does nothing

" thing in vain ; she goes not forward and backward by the same path. But if she make Bloud
 " of Chyle (*which is certain*) and then make
 " Chyle of Bloud again, she goes so. For Chyle
 " is a sort of Milk, as appears by the opening
 " of the Lacteal veins. If therefore that Chyle
 " be first excocted into Bloud, and then return
 " again to the nature of Milk, Nature should
 " certainly frustrate her first work.] We shall
 not therefore spend further time to refute so improbable (and now obsolete) an opinion ; but shall avow, that Chyle is the true matter out of which Milk is made, which is done after this manner.

The Chyle being received into the common *How milk*
 receptacle from the *Venæ lacteæ* of the Mesentery, *is made.*
 ascends up by the *Ductus thoracicus*, and by it is
 conveyed into the subclavian Veins, where it is
 mixed with the Bloud, and from whence it is
 circulated with it through the ventricles of the
 Heart. And when it comes out of the left Ventricle by the *Aorta*, a good part of it (as yet not assimilated to the Bloud) is sent to the Breasts by the Mammary and Thoracick arteries, whose Capillaries are inserted into the Glands, through which it is strained or filtrated into the *Tubuli lactiferi*, even as the *Serum* of the Bloud is separated from it by the Glands of the Kidneys into their *Tubuli* or Siphons. And as those Siphons of the Kidneys carry the *Serum* into the *Pelvis*, so do these of the *Mammæ*, the Milk into the common duct of the Nipple. As for the Bloud that came along with the Chyle to the Glands, that returns back again into the Subclavian and Axillar veins, and so to the Heart.

Tesides

Besides this matter of the Milk (*viz.* Chyle) Dr. Wharton (suitable to his Hypothesis of the *Succus nutritius* of the Nerves) thinks that the Nerves contribute their share, which he calls spermatick, for the nourishment and encrease of the spermatick parts of the Child. But if it should be supposed that the Nerves have such *Succus* in them (which we do not believe) what weakness must it needs induce upon the Mother to have so much of it (with the Animal spirits) daily drain'd out of them? whereas we see that many Women are more chearfull and heathfull when they give suck, than at other times. We cannot therefore consent to that opinion.

And here a most difficult question may arise, why the Chyle (whether it be brought by some *Venæ lacteæ*, or by the Arteries) flows onely to the Breasts at some certain times, and not always, seeing the Vessels that carry it are not obliterated, nor it self exhausted.

Why it
flows to
the breasts
at some
times
onely.

They that taught, that the Milk was made of Blood, and that that Blood was derived from the Womb by the Hypogastrick vessels into the Epigastrick, which latter they belived to inosculate with the Mammary; these I say deriving the Milk from the Menstrual blood as its matter out of which it is made, thought that the stopping of the *Menses* (as commonly happens to Nurses, unless very plethorick) occasioned the regurgitation of the Blood by the said vessels up to the Breasts, where so free a vent was found for it, after it was first changed into Milk by their Glandules. They assigned the same blood for the nourishment of the *Fœtus* in the Womb, and thought that after the birth it ascended up to the Breasts. But having in the former Book (Ch. 31.)

shewn

shewn that the *Fetus* is not nourished at all by the Mothers blood, as also in this Chapter that Milk is not made of it; we need not (though it were easie to) shew how ill this Hypothesis would satisfy the question, if blood should be supposed the matter out of which Milk is made. And indeed it is far easier to invalidate the reasons that have been urged for it, than to draw any from the new that are more satisfactory. So that as above (in Book I.) discoursing of the manner and matter of the nourishing the *Fetus* in the Womb, we scrupled not to expose our selves to the smiles of our so over-sagacious *Virtuosi*, in resolving all into the wise disposal of the Creatour; so we shall not be ashamed to profess our (I think invincible) ignorance here also, without giving this question any other resolution, than that it is so, because Providence has order'd it so to be. However we will not omit to give *Diemerbroeck's* opinion, which if it cannot satisfy, may for it ingeniousness delight.

"The cause of it (says he) is a *strong imagination*, or an intense and often thinking of Milk, Breasts and their Suction, which worketh wonderfull things in our Bodies: not indeed simply of it self, but by mediation of the appetitive power, or of the passions of the mind, which induce various motions on the spirits and humours. So the imagination and thinking of a great danger maketh a Man tremble, fall, be cold, fall into a swoon, yea hath sometimes turn'd his hair grey in a short time: The imagination of a joyfull matter causeth heat and animosity of the Body, thinking on a shamefull thing, or a view of it, causeth blushing; thinking on a terrible thing, paleness, on a sad thing, cold. Lustfull
R "thoughts

" thoughts make the Body hot, relax the strict
 " Genitals of Women, erect the *Penis*, and do so
 " open the seminary ways that are otherwise invi-
 " sible, that Seed issueth out of its own accord
 " in involuntary or nocturnal pollution. The
 " same intense imagination (*adds he*) and a desi-
 " rous cogitation of suckling the Infant, is the
 " Cause that the Chyliferous vessels (*by which*
 " *he means Venæ lacteæ properly so called*) are
 " loosened and opened towards the Breasts, espe-
 " cially if some outward causes tending that way
 " favour and further incite that strong imaginati-
 " on, as wanton handling of the Breasts, the mo-
 " ving of the *Fetus* in the Womb, the sucking of
 " the *Papilla*, &c. For according to the different
 " influx of the Animal spirits, the parts are some-
 " times straitned, sometimes relaxed, as every
 " one knows; and according to that different
 " constriction or relaxation the blood and other
 " impelled humours, flow sometimes more, some-
 " times less into the parts; and sometimes beget
 " heat, softness, redness; sometimes constricti-
 " on, cold and paleness. Amongst these impel-
 " led humours is the Chyle, &c. —] To
 confirm this opinion he gives several instances
 wherein nothing but imagination could move the
 Chyle to tend to the Breasts. His first is that
 known story of *Santorellus*, " That a poor Man's
 " Wife dying, and not having means enough to
 " hire a Nurse for the Infant she had left behind
 " her, he used, (to still it a little) often to lay
 " it to his Paps (without doubt (*says Diemer-*
 " *broeck*) with a great desire to yield it some
 " Milk) and so at length by that intense and con-
 " tinual thought, and often repeated sucking of
 " the *Papilla*, his Breasts afforded Milk enough
 " for

“for the suckling the Infant. (Which by the way seems to make much against his opinion of the Chyle's being conveyed to the *Mamma* by the *Vena lactea*; for seeing Men according to Nature give no suck, to what purpose should *Vena lactea* be distributed to their *Mammilla*? and yet here is an instance of a Man giving suck, and therefore the Chyle is more likely to be brought by the Arteries, which Men have as well as Women; unless we will grant that force to imagination, to make *Vena lactea* as well as to send the Chyle by them, which would be an equal force of imagination to imagine. But to proceed.) He tells another story of an old Woman that came to give suck, and he delivers it with such circumstances as may create a belief of the truth of it.

“At *Vyanen* a Town not far from us (*viz.* from *Utrecht*, in which Province it is) about thirty years agoe there was an Hostess that kept the Bores-head Inne without the Gate, who was brought to bed a little after her Husbands death, and died in Child-bed or very soon after, leaving a healthfull Child behind her: and having left very little Estate, her Mother whose name was *Joan Vuyltuyt*, being also poor and not able to put it out to Nurse, yet had such pity on her Daughters Child, as to undertake to nourish it, and she was now threescore and six years old. Now having sometimes used, with the greatest commiseration, to hold it to her Breasts when it cried, and offered it the Nipple to suck; by that strong imagination, and desirous cogitation of nourishing the Infant, her Breasts began to give Milk, and that in a few days so plentifully, as was abundantly sufficient to feed the Child, so that it had scarce any

“need of other sustenance : and so, to the admiration of all, the Infant was well nourished with the Milk of this old Woman, whose Breasts for many years had been wither’d and flabby, but now became plump and full like a young Woman’s. There are many still alive in that City that remember the thing very well.] I confess the story is very odd, but whether to be resolv’d into the force of imagination I leave the curious to meditate. However he very plausibly answers several objections that may be made against it, which it will be worth the while for the Latine Reader to peruse, in his *Anat. corp. human. lib. 2. cap. 2. p. 409, 411, &c.*

The two other *external* proper containing parts of the *Thorax* are the *Muscles* and the *Bones*. But of these we shall omit the description here, having thought it more convenient to treat of all the *Muscles*, and all the *Bones* of the whole body in two distinct Books, *viz.* of the *Muscles* in the *fifth*, and of the *Bones* in the *sixth* : And as for these of the *Thorax* in particular, the *Muscles* are described in Chap. 15. of B. 5. and the *Bones* in chap. 11, 12, 13. of B. 6.

C H A P. III.

Of the internal proper containing parts.

THE internal proper containing parts are in number three, the *Pleura*, the *Mediastinum* (with the *Thymus* growing to it) and the *Diaphragm*.

The *Pleura* hath its denomination from the *Pleura*. Ribs which it cloaths on their inside, (for a Rib is in Greek called *πλευρά*) and so it may be termed in English, the *Costal membrane*.

It is membranous, white, thin and hard, resembling the *Peritonæum*, and lining all the cavity of the *Thorax*. Its substance.

Spigelius de human. corp. fabr. lib. 9. cap. 3. will have it to be thicker and stronger than the *Peritonæum*, contrary to the opinion of *Riolanus*, who affirmeth the *Peritonæum* to be thicker and stronger, because it is appointed for sustaining the weight of the *Guts*.

It consists of a double membrane, of which Parts. the inner, or that next the cavity, is thickest. This is smooth on its inside, and bedewed with a waterish humour, that the Lungs might play against it without any prejudice. Sometimes on one side, and sometimes on both it sends forth (on its inside) certain nervous fibres (even in healthfull persons) which being inserted into the investing membrane of the Lungs do so fix them in their place as to hinder that liberty of ascent and descent in respiration which is natural to them, and yet many times without any notable injury to their breathing. Though sometimes

(as *Spigelius* has observed) they tie the Lungs so very close to the sides, as to cause a continual and incurable *Dyspnœa*. As to that waterish humour that bedews the inside of this membrane, it seems to proceed from vapours raised from the Bloud, and condensed by the respective coldness of this Membrane. The outer membrane is thinner, and rough on its outer surface, that it might cleave the more firmly to the Ribs and Muscles by the intervention of their proper membrane.

Figure.

As for its *figure*, without it is arched, within hollow; above it is narrower, below broader, being chiefly widened side-ways.

Holes.

Above, it is perforated in six or seven places, to give way to the *Vena cava* descending, and the *Aorta* ascending, the *Gula*, the Wind-pipe, Lacteals, Lympheducts and Nerves. Below, where it covereth the Midriff, it is perforated in three places, to give way to the *Vena cava* ascending, and the *Aorta* descending, as also to the *Gula*.

Rise.

It is said to have its *rise* from the Membranes covering the *Spinalis medulla*; however, it adheres very close to the *vertebræ* of the Back, from whence it comes forward on each hand by the sides to the Breast-bone, under which the Membranes of each side are joyned together, and so becoming double it goes back again streight from the middle of the Breast to the Back, dividing the cavity of the *Thorax* into two parts, like a partition-wall, and one Lobe of the Lungs from the other: and this is called *Mediastinum*, of which by and by.

Veins.

Its *Veins* spring from the superiour Intercoastal branch, and from the *Vena sine pari*.

Arteries.

The *Arteries* in like manner proceed from the superiour Intercoastals, (which arise from the Subcla-

Subclavian) and these descend to about the fourth Rib, below which it has its Arteries from the hinder part of the *Aorta* descending.

It hath *Nerves* from twelve vertebral pair, viz. *Nerves*. from all the pairs of the *Thorax*; for from betwixt each of the twelve *vertebrae* of the Back there springs a pair of *Nerves*, and each is immediately divided into the *fore-* and *hinder-branches*: The *fore-branches* are they which serve the *Intercostal* muscles, external and internal, and also the *Pleura*: as for the *hinder*, they are bestowed upon the *Muscles* which lie on the Back, &c.

The *Veins* and *Arteries* according to *Spigelius* run between the two *Membranes* of the *Pleura*, and therefore he thinks that when an inflammation of the *Pleura* (called a *Pleurisie*) imposthumates, the matter is rather gathered betwixt its *Membranes* than betwixt the *Intercostal* muscles and it.

The second *internal* proper containing part is Of the Me- the *Mediastinum*: so called because it standeth in diastinum. the middle of the Breast, and divideth its cavity into two partitions, viz. a right and left.

It springeth from the *Membranes* of the *Pleura* Its rise. meeting at the *Sternum*, (as was said before;) so that at its rise it consists of four *Membranes*, because the *Pleura*, of the duplicature whereof it is made, consists of two. But as the *Mediastinum* tends from the *Sternum* through the middle of the *Thorax* towards the Back, its duplicated *Membranes* are so severed, that the *Heart* with its *Pericardium* are contained in the cavity that is formed by their separation. Yet when they arrive near the Back, they join one to another again as close as they did at the Breast, though they

they presently part again, (saith *Dietmerbroeck*) and make another narrower Cavity, but as long for the Gullet, &c. to descend by. Some have formerly imagined a third Cavity at its origine under the *Sternum*, as in particular Dr. *Higmore*, who says the interstice betwixt the membranes is large, and yet (he says) they are knit to one another by certain fibres. In this cavity, he thinks, there are thick vapours and *flatus* sometimes contain'd, which cause very acute pains there, by retching the membranes and violating the fibres that knit them together. But in truth there is no such cavity, nor consequently any such vapours, or pain depending thereupon. For though indeed, if the dissection be begun at the *Sternum*, when one has pull'd it off from the *Mediastinum*, one would think at first sight that there were as great a distance betwixt the membranes of the *Mediastinum*, as the *Sternum* is broad: yet if one begin the Section at the Back, and loose the Ribs there, and so come to the *Sternum*, he will see the *Pleura* doubled knit close to the *Sternum* without any Cavity.

Substance. The substance of it is like that of the *Pleura* from which it springs; onely where it is parted, it is thinner and softer than the *Pleura*. The outer side towards the Lungs is smooth, but the interior is rough, by reason of the Fibres whereby it adheres to the *Pericardium* in some places, and by which its own two Membranes at their meeting are united. It is sometimes pretty well stor'd with fat especially about its vessels, somewhat like the Caul in the *Abdomen*.

Veins. As for its Vessels: *Veins* and *Arteries* it hath
Arteries. from those called *Mammariæ internæ*, but small; and *Veins* besides from *Vena sine pari*,

It hath moreover one special Vein called *Mediastina*, which springeth from the lower side of the *Ramus subclavius*.

The Nerves called *Phrenici*, and *Stomachici*, *Nerves* springing from the sixth pair, (Dr. *Willis's* eighth) descend betwixt its Membranes, and send forth small twigs into it.

Bartholin says it has *Lympheducts*, which rising here and there in many Rivulets, enter the *Ductus thoracicus* at last in one channel. These (he says) imbibe the water that is condensed betwixt its duplicature, and convey it into the said duct.

It hath three uses: First, it divideth the Breast and Lungs into two parts, that one part being wounded or any way hurt, the other might perform the office of respiration.

Secondly, it holdeth up the Heart inclosed in the *Pericardium* so, that it may not rest upon the Back-bone, when we lie upon our Back; or fall upon the Breast-bone, when we bend our selves towards the ground; or touch the Ribs, when we lie upon our Sides.

Thirdly, it giveth a safe passage to the Vessels which pass by it, and holdeth up the Diaphragm so that it is not pulled too much down by the weight of the Bowels that hang by it, viz. the Liver and the Stomach.

To the upper part of the *Mediastinum* at the Throat there groweth a glandulous body called *Thymus*, seated between the divisions of the Subclavian veins and arteries. It is a whitish, soft, spongy body, (in shape resembling a Tyme-leaf, from which it has its name.) It is larger in Children and Women than in Men. In Infants it consists of three Glands, and is in substance something like the Sweet-bread; but in adult persons it

it dries up and contracts into one continued substance.

Its vessels.

The Jugular *Veins* and *Arteries* pass through it as they go up to the Neck, but if they send forth any twigs into it, they are so small as not to be discovered in dissecting it. Dr. *Wharton* says it has *Nerves* from the sixth pair (Dr. *Willis's* eighth) and from the subclavian *Plexus*, which deposite their *Succus nutritius* in it, whose superfluous or impurer parts are separated from in this Gland and conveyed away by the *Lympheducts*, and the refined liquor is resumed by the *Nerves* dispersed in it, for the use of the nervous parts of the whole Body. And because he foresaw how open this opinion (which himself calls *scruposa sententia*) lay to the objection, that it is very improbable that the *Nerves* should bring the *Succus nutritius* to this part, and after depuration should resorb it; he answers that either the *Nerves* must do it, or it cannot be done at all, seeing there are no other *Vessels* fit for the resuming of it. But he had better have suspected his supposed office of the *Thymus*, when he saw himself so hard set to maintain it. For it is more probable that when there is found any whitish liquor in it, (as there is in Infants, and in Calves, &c.) that liquor is Chyle which is brought thither by *Lacteals*, and descends from thence into the Subclavian veins; seeing if one kill a Calf about two hours after it has been plentifully suckled, the *Thymus* abounds with this juice, as *Diemerbroeck* affirms; who also denies that there are any perceptible *Nerves* inserted into it, but grants *Lympheducts*, which empty themselves into the subclavian vein.

Use.

Its uses are, first, to prop and strengthen the divisions of the *Vessels*, namely of the *Vena cava* and

and ascending *Aorta* ; and secondly, to defend them from compression by the *Claviculae* , in stooping forward. In adult persons it seems to be of little other use ; but in Infants , in whom it is larger and has liquor like Chyle in it, it seems to contribute something towards the refining or depuration of it.

The third and last internal proper containing The Diaphragm, part is the *Midriff* or *Diaphragm* (derived ~~and to~~ *Diaphragm*, to distinguish, because it divides the trunk of the Body into two Ventricks, the *Abdomen* and *Thorax*.) It is also called *σπλῆν*, or *σπέρν*, the mind, because when it is inflam'd or otherwise much distempered, the mind and senses are disturbed, through the great consent it has with the Brain, as being a very nervous part. The Latines call it *Septum transversum* for the same reason as the Greeks call it *Diaphragma*.

Now this part being truly Muscular, and assisting respiration, we might on that account have deferred to treat of it till we come to describe the Muscles of the *Thorax* : but because it is wholly an internal part, and serves to compose the cavity of the Breast, we rather chuse to discourse of it here, and omit it in the treatise of Muscles.

It is almost round, (excepting its two appendages whereby it is fastened to the *vertebrae* of the back and Loins) and is seated transversely or across the Body, onely sloping a little backwards. It is as broad as the width of the *Thorax*, for its edges are fastened to the lower part of the *Sternum*, to the ends of the lowest Ribs, and to the lowest *vertebra* of the *Thorax*. Its figure and situation.

Its substance as was said but now is muscular, consisting of carnos and tendinous fibres like other

ther Muscles. But whereas it has constantly been described by all former Anatomists as one Muscle, *Caspar Bartholin* has demonstrated it to consist of two, an upper and a lower, (or a fore and an hinder) to which discovery he was partly directed by *Steno's* observations, who first question'd the generally suppos'd fabrick of this part.

It consists
of two
Muscles.

I say it consists of two Muscles, an *upper* and a *lower*, which are thus described by the aforesaid Author.

"The *Upper* Muscle by one end (*viz.* its head) adheres circular-wise to the Ribs and to the *Appendix* of the *Sternum*; the other passeth into the Tendon which makes the *nervous centre* of the Diaphragm (as they call it) and is spent on (or continued unto) the flesh of the lower Muscle, (and so the whole Midriff becomes like one digastrick or double-bellied Muscle.)

"The *Lower* springs from the *vertebræ* of the Loins, and neither proceeds from the other, nor touches it but by the mediation of the Tendon (for though the fibres of each Muscle seem sometimes to mix a little one with another on the lower side, yet that is onely by mediation of each of their Tendons.). Those two *Appendices* (as they are called) of this lower Muscle whereby it adheres to the *Vertebræ*, have by all Anatomists been represented as if they were of the same length; whereas indeed they are not so, for the right is both longer than the left, and very much exceeds it in the number of car-nous and tendinous fibres. Yea the right arises from (or rather terminates into) the first, second and third *vertebræ* of the Loins, as from so many heads; and the left from the last and last but one of the Back.

As to the course of the *Fibres* of both these Muscles, because they are better apprehended by the view than they can be by the description, I shall wave this latter, and content my self with exhibiting to the eye of the Reader a scheme of these Muscles in *Tab. 12. fig. 2. & 3.* from the said Author.

The upper side of the Midriff is cloathed with Mem-
the *Pleura*, and its lower with the *Peritonæum*. *branes.*
To the upper membrane the *Mediastinum* and *Pericardium* are knit, and sometimes the lowest tips of the Lobes of the Lungs, but that connexion is preternatural.

It is perforated on the right hand in (or near) *Holes.*
the nervous centre by the trunk of *Vena cava* ascending from the Liver; and on the left hand a little more backwards, its lower Muscle in its upper part is perforated by the Gullet and two Stomachick nerves springing from the *par vagum*; and in its lower or hinder part, *viz.* betwixt its two appendages or productions there descend the *Aorta*, a branch of the *Vena azygos*, and the Inter-costal nerve (distinguisht from the *par vagum* by Dr. *Willis*) for the use of the parts of the *Abdomen*.

It has been said to have two *Arteries*, called *Vessels.*
Phrenicæ, from the *Aorta* descending, and as many *Veins* from the trunk of *Vena cava* ascending through it. But the above-mentioned *Bartholin* says, that the lower Muscle has peculiar blood-vessels. "For besides those *Veins* that spring from the *Cava*, (which provide for the upper Muscle and middle part of the lower) this lower "has on each side peculiar and notable ones which "arise from the *vena adiposa*, to which as many "Arteries answer in like manner springing from "the

“ the *Lumbares*, yet at a different origine from
 “ those other that accompany the above-mentio-
 “ ned Veins that spring from the *Cava*.] It has
 a peculiar *Nerve* which springs from the *brachial*
Nerves with a double or triple Root; namely
 two or three slips, proceeding from the aforesaid
Nerves, grow into one trunk, which is the
Nerve of the *Diaphragm*. The first and chiefeft
 slip is produced from the second vertebral *Nerve*:
 and the trunk that is made up of all the three,
 descends down the neck and through the cavity
 of the *Thorax* without any ramification as far as
 the Midriff, where being divided again into two
 or three slips, on each side it is inserted into its
 fleshy or muscular part. Now because the In-
 tercostal pair, according to Dr. *Willis*, has com-
 munication with the Vertebral from whence this
Nerve of the *Diaphragm* springeth, yea with
 this *Nerve* it self, (for he says that two or three
Nerves are sent from the cervical *Plexus* of the
 Intercoftal into the trunk it self of the *Nerve* of
 the *Diaphragm*) that learned Author very inge-
 niously gives a reason of the great consent of the
 Midriff with the Heart, Brain and Face, when a
 Man laughs. “ For, *says he*, as often as the ima-
 “ gination is affected with some pleasant or won-
 “ derfull conceit, the Heart would presently fain
 “ triumph (*ovare*) and be lighten’d by throwing
 “ off its burthen as it were: wherefore that the
 “ Bloud may the quicklier be emptied out of its
 “ right Ventricle into the Lungs, and consequent-
 “ ly out of the left into the *Aorta*, the *Diaphragm*
 “ being instigated by the *Nerves* that goe to it
 “ from the abovesaid *Plexus*, is drawn upwards
 “ with a more rapid *Systole*, and often repeating
 “ its jumps as it were, it bears up the Lungs, and
 “ causes

"causes them the quicker and frequenter to dis-
 "charge the Air and Bloud: and then inasmuch
 "as the same Intercoſtal nerve, that communi-
 "cates below with the Nerve of the Diaphragm,
 "is alſo continued above with the Maxillar
 "nerves, when a cackling is begun in the Breſt,
 "the geſtures of the Mouth and Face pathetical-
 "ly answer thereto.] And when the Diaphragm
 is wounded in its nervous part, then the Muſcles
 of the Face ſuffer Convulſions, and the laughter
 called *Riſus Sardoniſ* (which is involuntary) is
 cauſed. Beſides the abovesaid peculiar Nerve,
 it has ſecondly ſmall twigs from the Stomachick
 Nerves and Intercoſtal as they deſcend through
 it.

Its uſe is *fiſt* to divide the *Thorax* from the *Abdomen*, that noiſom and impure vapours may
 not aſcend from the more ignoble parts (as the
 Guts,) to offend the more noble (as the Heart,
&c.) *Secondly*, to help the Muſcles of the *Abdomen*
 in excluding the excrements, and (in Women)
 the *Fetus*. But *thirdly*, its chief uſe is to aſſiſt re-
 ſpiration, in which, as * *Steno* obſerves, "it ſelf **De Muſc.*
 "rather becomes leſs convex, than its compaſs & gland.
 "contracted. For, ſays he, all the lines which you *P. 11, 12*
 "pleaſe to conceive from the *vertebræ* to the reſt
 "of its circumference, both when it is relaxed,
 "and when it is ſtretched out and becomes ſtiff,
 "are crooked in ſome part of them, looking to-
 "wards the *Thorax* with their convex ſide, and
 "towards the *Abdomen* with their concave. Theſe
 "lines the leſs they are extended, the more con-
 "vex they are; whereby the *Abdomen* is ſo much
 "the larger, and the *Thorax* the ſtraiter: and the
 "more they are contracted, by ſo much the ſur-
 "face of the Diaphragm is the leſs convex;
 "whereby

" whereby the *Thorax* is so much the larger, and
 " the *Abdomen* the straiter. And so the bottom
 " of the *Thorax* (*viz.* the *Diaphragm*) in inspi-
 " ration is more depressed, but in expiration af-
 " cends.] Thus far *Steno*, to whom (the often
 " mentioned) *Bartholin* assents, who says "that its
 " first motion is performed downwards, which
 " the Lungs following, draw in the Air; and by
 " and by it is moved upward, whence the Lungs
 " being compressed, the Air with the vapours
 " that are mixt with it are excluded. So that
 " from a convex laxity it comes to plainness (in
 " inspiration) but is not at all extended. Not-
 " withstanding in expiration (which *Diemerbroeck*
 " has well observed) it is first of all stretched as
 " it were with violence, but it is presently rela-
 " xed again, and by drawing the Ribs together
 " with that tension it begins expiration with some
 " force, and then the Ribs following it, its ten-
 " sion presently ceases, and it becomes lax. Which
 " procedure *Diemerbroeck* illustrates with a pretty
 " and pat similitude, when he affirms it to be
 " done in the same manner as when Bells are
 " rung with long ropes; in which action the
 " rope is first stretcht with violence, but because
 " the bell doth presently follow that violence,
 " hence the rope forthwith becomes lax untill,
 " the bell being turn'd about to the other side,
 " the Ringer do again stretch the Rope with the
 " like violence, and draw it back again.] At
 " length *Bartholin* concludes, "When the Dia-
 " phragm is compressed into the *Abdomen* (in in-
 " spiration) the *Thorax* is elevated, otherwise than
 " others think who suppose the depression of the
 " *Diaphragm* to cause a depression of the *Thorax*.
 " But in-Expiration the *Diaphragm* being driven
 " upwards,

"upwards, the Breast is contracted, the Breast
 "being contracted presses the included air, the
 "air the surface of the Lungs, that the air may
 "be driven from the *Vesiculæ* into the branches of
 "the *Trachea*, whither as soon as it is come, the
 "rings of the *Trachea* are contracted by the in-
 "termediate fibres and drive forth all the air;
 "and on this manner does Respiration proceed,
 "all the cells of the Lungs being fill'd again by
 "and by in Inspiration.

Its motion seems to be a kind of mixt motion, *The na-*
 but rather *Animal* than *Natural*; for though we *ture of its*
 move it in our sleep, and so it may seem natural, *motion.*
 yet seeing when awake we can stop, slacken or
 hasten its motion as we please, it seems to be vo-
 luntary or animal.

And thus much of the parts containing, now to
 the parts contained.

C H A P. IV.

Of the Pericardium, and the Humour con-
 tained in it.

THE parts contained are either *Viscera* or *Vasa*,
 Bowels or Vessels.

The Bowels are the Heart and Lungs. But *Pericardium.*
 the Heart being inclosed in a membranous cover
 called *Pericardium*, we will first treat of it, in
 this Chapter.

It is called *Pericardium* because it is placed *Its Name.*
 about the Heart. It is called also

S

Capsula

Capſula cordis, the Heart-caſe, and *involucrum*, the Cover, &c.

Subſtance
and Fi-
gure.

It is membranous, and encompaſſeth the whole Heart, whoſe ſhape it therefore reſembles, but is larger, both to grant a free motion to the Heart, and to contain its proper liquor.

Origine.

It ſprings at the Baſis of the Heart from the outer common Coats (that are borrowed of the *Pleura*) of thoſe Veſſels that enter into the Heart.

Holes.

Whence it has *five holes* according to the number of Veſſels that go in or out of the Heart. As firſt one made by the aſcending trunk of the *Cava*, another by the deſcending, both which enter the right Ventricle of the Heart, from whence there goes out *Vena arterioſa* into the Lungs, which makes a third hole. A fourth is made by the *Arteria venoſa* entering the left Ventricle of the Heart, and a fifth by the *Arteria magna* going out of the ſame.

Connexi-
on.

Its outſide adheres to the *Mediaſtinum* by many Fibres, and is continued to it at the baſis of the Heart, where the Veſſels perforate it. Its lower end is knit firmly to the centre or nervous part of the *Diaphragm*, which (*Bartholin* ſays) is peculiar to men, for in all other Creatures it hangs looſe.

Veſſels.

It has *Veins* below from the *Phrenica*, above from the *Axillares*. Its *Arteries* are ſo ſmall that they can hardly be diſcover'd. It receives *Nerves* from the eighth pair (heretofore reckoned for the ſixth). Dr. *Willis* ſays, "It has a great many "twigs of Nerves from that *plexus* of the *par va* "gum that is over againſt the firſt or ſecond "Rib, and that it has ſo many for this reaſon, "viz. That ſeeing it is appointed for a defence

"to

“to the Heart, as often as any offensive matter
 “invades or besets it (self); it may be able to
 “contract it self and shake off its enemy: for it is
 “likely that *tremors* and *inordinate vibrations* of
 “the Heart, which in truth do manifestly differ
 “from its *natural pulse*, do proceed from the vio-
 “lent succussion of this membrane. } *Bartholin*
 affirms it to have *Lympheducts* also; which is very
 probable; that they may absorb part of the liquor
 contained in it, lest it abound too much, seeing it
 receives continual supply: for I am not of opini-
 on that this liquor is spued out of the *Lymphed-*
ucts, as *Sperio* thinks, but that they rather im-
 bibe it and convey it to the *Ductus thor-*
cicus.

It contains in it a serous liquor, that in health-Its liquor.
 full Bodies is a little reddish, much like water
 wherein flesh has been washed. It is bred of va-
 pours exhaling from the Heart, which are stopp'd
 by this dense Membrane, and condensed into hu-
 mour. Dr. *Lower* opposing this opinion, brings
 for argument, that if it were collected this way,
 because it would be continually a gathering, it
 would soon encrease so much that this *Cap/sula*
 could not hold it. But the abovesaid *Lympheducts*
 absorbing what is superfluous, wash away this ob-
 jection; which if they did not, his own opinion
 that it drops out of the Glands seated at the basis
 of the Heart, would be liable to the same incon-
 venience. For such destillation would be as con-
 tinual as this condensation is supposed to be.
 Naturally it is not in quantity above two spoon-
 fulls, (though it differ much according to the
 temperament of the party, the hot having a smal-
 ler, and the cold a larger quantity) But in disea-
 sed persons it is sometimes increased to half a
 S 2 pound,

pound, yea to a whole pound, as *Diemerbroeck* has oft observed. This is that liquor that is supposed to have flown from the Side of our Saviour when the Souldier pierced it with a Spear, for saith the Text (*John 19. 34.*) *There came forth blood and water.* Sometimes Worms have been observed to breed within this bag, and such persons, when they were alive, have been subject to palpitation of the Heart, and swoonings.

Their uses. The *Pericardium* is some sort of fence to the Heart, but it seems to be chiefly made for the sake of the liquor it contains, which serves for the moistening of the Heart and making its superficies slippery, that it may move more glibly.

~~It contains a liquor, that in health is a little viscid, but in disease it becomes much like water.~~
 C H A P. V.
 Of the Heart, in general, and of the reason of its Motion.

The Heart. THE Heart (in Latine *Cor*, in Greek *καρδιον*, or *καρδια*, *καρδιον*, *καρδιον*, because it is the source of vital heat) is the principal Bowel of the whole Body, which no perfect Animal does want, nor can long survive its wounds. Vital spirit and natural heat are communicated from it to all the parts of the Body, though they are not so much owing to its substance as to the ebullition or accension of the Blood and Chyle in it; as shall be discoursed hereafter.

Its situation.

It is seated in the middle of the Breast, encompassed with the *Pericardium* and *Mediastinum*, its lower tip or *Mucro* bending a little to the left side.

side. Neither its *Macro* nor sides are knit to any place; but it hangs loose in its Case; onely suspended by the vessels that go in and out of its upper part or basis, to which the *Pericardium* adheres. Its situation in Beasts that feed upon Grass is near the middle of the whole Body, reckoning from the Head to the Tail; but in Man (and most carnivorous Animals which generally have shorter necks than others) it is nearer the Head; whereof the learned Dr. *Lower* gives an ingenious reason. "Seeing, says he, the trajection and distribution of the Blood depends wholly on the *Systole* of the Heart, and that its liquor is not driven of its own nature so readily into the upper parts as into Vessels caved with it, or downwards into those under it: if the situation of the Heart had been further from the Head, it must needs either have been made stronger to cast out its liquor with greater force; or else the Head would want its due proportion of Blood. But in Animals that have a longer Neck, and which is extended towards their food as it were, the Heart is seated as far from the Head as from the other parts; and they find no inconvenience from it, because they feed with their Head for the most part hanging down, and so the Blood, as it has farther to go to their Head than in others, so it goes a plainer and often a steep way.

It has a firm, thick, dense substance, thinner and softer in the right side, thicker and more dense in the left, but most compact and hard at its tip; onely on the left side of the tip it is thin, as consisting mostly of the concurrence of the inner and outer Membrane. Its *Furcenchyma* is for the greater part made up of muscular Fibres, so that

Fibres.

that it self may truly be reputed a Muscle. Its *Fibres* are a few of them streight, but far more oblique. Both are inserted into a Tendon that is spread over its basis under the Auricles. Part of which Tendon at the egress of the *Aorta* in some Creatures becomes bony, as in a Stag, &c. On the outer superficies of the right Ventricle there run a few slender *Fibres* streight upwards, and are terminated in its basis. In which also terminate the oblique ones next under these, ascending from the left side towards the right, spiral-wise. The *Fibres* that lie under these, hold a clean contrary course. For they arise every where from the right side of the Heart, whence being carried obliquely towards the left, and having embraced each Ventricle of the Heart, they ascend to the basis of the left side spiral-wise as the other. But they run not all of them the whole length from the basis to the cone; for then would the Heart be as broad or thick at the lower end as the upper: but some reach not above half way, others a little further, &c. and some to the very *Apex*. The *Fibres* of the left Ventricle differ not from those of the right as to kind, onely they are considerably stronger. Which they are for this reason, that whereas the right Ventricle onely promotes the circulation of the Bloud through the Lungs, the left must cast it forth with that force as that it may circulate through the whole Body.

The curious Reader may find a most accurate description of these *Fibres* in Dr. *Lower's* treatise *de Corde*; whither I refer him; for, to insist too long on such minute similar parts, would not be suitable to this Epitome of Anatomy. Though by a view of those Figures that I have borrowed

of Him, their structure may be pretty plainly apprehended.

Its *shape* is like a Boy's top (save that it is flat-tish behind) or a Pyramid turn'd topsie turvy; whence it is divided into its basis, which is its broader part and upper; and into its cone or apex, or narrower and lower part, which ends in a tip or *mucro*. Figure.

It is *bigger* in Men than in other Creatures, considering the proportion of their Bodies. It is lesser but more dense in hot and bold Men, than in the cold and cowardly. In adult persons it is commonly six fingers breadth long, and four broad at the basis. Bigness.

Outwardly it is covered with a proper Coat, which is thin, but strong and dense, and very hard to separate from it; it is the same with the outer Coat of the great Artery, as that which cloaths the Ventricle on the inside is continued and common with that thin skin that covers the inside of the Arteries like a *Cuticula*: and hence 'tis likely (says *Diemerbroeck*) that the Arteries borrow these Coats of the Heart, as the Nerves borrow their two Tunics from the *Pia* and *Dura mater* of the Brain. Upon this Membrane that invests the Heart, there grows some hard fat about the basis, which serves to moisten it. Coat.

It is not nourished by the blood or chyle that are received into its Ventricle, but by Vessels running through its *Parenchyma*. Vessels.

Its Arteries are two, springing out of the *Aorta* before it pass out of the *Pericardium*, and are called *Coronariae*, because their trunks do not presently enter into the *Parenchyma* of the Heart, but fetching a circuit on its surface the better to Arteries.

branch out themselves towards its cone, they encompass its basis like a diadem. And though at their rise they turn one on one side and t'other on the other of the Heart, yet at their ends they meet again and inosculate one with the other: so that if one inject any liquor into one, it will run into the other.

Veins.

It has also two *Veins* called *Coronariae* which encompass its basis in like manner, and communicate one with the other. These receive and carry back the Arterial blood that remains from the nutrition of the Heart, and refund it into the *Cava* just at its entrance into the right Ventricle.

Nerves.

Its *Nerves* do arise chiefly from the *plexus cardiacus* of the *par vagum* or eighth pair, into which *plexus* many twigs do enter from the Intercostal. But a little below this *plexus*, after the recurrent Nerve has parted from the trunk of the *par vagum*, the *par vagum* sends forth on each side a notable branch; which being carried towards the Heart, and creeping along its basis behind, meet one another, and in all their progress send forth twigs through the whole surface of the Heart, especially on its backside: as those branches which proceed from the *plexus cardiacus*, are dispersed chiefly on its foreside, as Dr. Willis affirmeth.

The cause of the motion of the Heart.

Great controversie hath been and still is about the motion of the Heart, whether it depend on the influx of the animal spirits, or on the accension and dilatation of the blood in its Ventricles, or partly on one, partly on the other. Plausible Arguments are produced on every side, but such as rather tend to shew the shortness and insufficiency of the contrary opinions to solve this Phenomenon,

nomenon, than pretend to demonstrate any certain reason of it. That the immediate instruments of its motion are its Fibres, none can doubt; but what sets these Fibres on work is all the question. That it cannot be the Animal spirits conveyed by the Nerves (*onely*) is apparent, *first*, because the Heart moves in the *Embrya* before either Brain or Nerve are so perfectly formed, that the Animal spirits can be elaborated out of the Blood by the former, or transmitted to the Heart by the latter: yea seeing they are made of Arterial blood, that must be sent to the Brain by the pulsation of the Heart before they can be generated. And *secondly*, because those muscular motions that depend on the influx of the Animal spirits, are voluntary, which this of the Heart is not, for we can neither stop it nor hasten it at our pleasure. *Lastly*, because the Heart of living *Fœtus's* (as of young Puppies) and of Eels, being cut out of the Body and from all the Nerves by which any Animal spirits should flow into it, will continue beating as long as 'tis warm: yea when it has ceas'd beating, if one throw warm blood or but warm water upon it, it will recover some kind of pulsation again. Which may serve also to convict the second opinion of error; for if its motion depended *onely* on the dilatation or rarefaction of the blood, it would cease as soon as the blood flows no longer into its Ventricles.

And for a further confutation of the second opinion, which supposes the accension (and consequent dilatation) of the blood as the cause of this pulsation, Dr. *Lewer's* Experiment, or his Observation, seem argumentative beyond contradiction. His experiment is this: "He drew
out

"out of the *Jugular* vein of a Dog about half
 "of his blood away, injecting by turns into
 "the *Cervical* vein a like quantity of Beer mixt
 "with a little Wine; and this he repeated al-
 "ternatively so often, till instead of blood
 "there flow'd out of the Vein onely a paler
 "tincture like water wherein Flesh had been
 "wash'd, or Claret diluted with very much Wa-
 "ter; and yet the Heart in the mean time re-
 "mitted but a little of its former pulsation.
 His *observation*, which he had from a Physician
 worthy of credit, is this: "A Youth about six-
 "teen years old, continuing bleeding for two
 "days together, his friends and those that waited
 "on him gave him good store of Broth to keep
 "up and recruit his Spirits; which swallowing
 "down greedily, his bleeding was now and
 "then encreas'd thereby, so that at length hav-
 "ing poured forth almost the whole mass of his
 "blood, that which now run out was dilute
 "and pale, neither of the nature nor colour of
 "blood, but liker the Broth he had drunk so
 "much of: and this kind of flux continued a day
 "or two, (the Heart the mean while retaining
 "its pulsation) till at length being stop't, the
 "Youth was restored by degrees to entire health,
 "and grew to a robust and lusty Fellow.] This
 experiment and observation I say do make it ap-
 parent, the motion of the Heart depends not on
 the accension and dilatation of the Blood, for
 then when in the first the Beer and Wine, in
 the second the Broth flow'd into its Ventricles in
 stead of Blood, its motion must either have been
 more notably alter'd, or rather have quite ceas'd,
 these liquors being so far distant from the nature
 of blood; especially the Broth.

And

And lastly, that this motion is not caused partly by the influx of the animal spirits, and partly by the accension and rarefaction of the blood, may be evinced by the Arguments produced against each opinion apart : and yet if a reason could be given, this seems the most probable. Namely, that the blood destilling into the Ventracles of the Heart, is in them accended and rarefied, so that requiring a larger space it bears against their Sides : whereby the Heart being molested, it calls in the Animal spirits for help, which coming in in convenient plenty contract its muscular Fibres, and so by straining its Ventracles drive forth the blood contained in them into the Arteries. But we had rather ingenuously confess our ignorance of the reason of so admirable an action, and profess with Dr. Lower, that it is too hard for Man to conceive of; and that it is the prerogative of God onely, who *searcheth the secrets of the Heart*, to know the reason of its motion also.

CHAP. VI.

Of the Pulse, and the circulation of the Bloud.

THE motion of the Heart is called in Greek *The Pulse*. in Latine *Pulsus*, pulse or beating. And this is performed by *Diastole*, or Dilatation, in which it receives Blood into its Ventracles; and *Systole*, or Contraction, by which it expells it out of them.

Con-

Systole
and Dia-
stole.

Contraction being the proper motion of a Muscle; the *Systole* is the proper motion of the Heart; and the *Diaſtole* is but a ceasing or restitution from that motion. For in the *Diaſtole* the Fibres of the Heart are relaxed, during which the Blood destills down into its Ventracles out of the Auricles; whereby when they are filled and in some measure distended, the Fibres both streight and oblique begin to contract themselves, and compress or straiten the Cavities of the Ventracles, not onely by constringing their sides, but also by drawing up the cone or tip of the Heart nearer its basis, whereby their cavity is shortned, so that the Blood is expelled with force out of them into the Arteries; which motion is called the *Systole*. But why the Heart should keep such stated turns of *Systole* and *Diaſtole*, and continue them for (it may be) fourscore years together; that (as we said above) we cannot conceive the reason of, but admire the wisdom and power of the Creatour, in beginning and continuing such a motion.

The circu-
lation of
the blood.

Now seeing by this continual reciprocation of the Pulse, there is a constant expulsion of Blood from the Heart into the Arteries, and as continual an influx of Blood into it out of the *Cava*; and seeing the *Cava* from whence the supply is, is never drawn dry, nor on the other hand, the Arteries that receive the Blood continually from the Heart, unduly swell'd with it; it necessarily follows, that this motion proceeds circularly, viz. that the Blood is continually driven out of the Heart into the Arteries, out of these into the parts to be nourished; from whence it is reſorbed by the capillary Veins, which conduct it back through the larger into the *Cava*, and so

at length it returns to the Heart again. The invention of which circulation is owing to our Countreyman Dr. *Harvey*, and may be prov'd indubitably by these reasons.

1. The great quantity of Blood that is driven out of the Heart into the Arteries at every Pulse. For though the Ancients who knew not this circulation, imagin'd that onely a drop or two were expelled by every *Systole*, which they were necessitated to suppose, to avoid the great distension that the Arteries must be liable to, if any considerable quantity issued into them; yet it is certain and demonstrable that there must needs an ounce or more be driven into them each time. For (taking it for granted that there is no other way for any liquor to pass from the Stomach to the Kidneys but through the Heart, along with the Blood) seeing if some Men at some times drink three pints of Drink, they shall piss it out again in half an hour, yea more of *Tunbridge Waters* in that space; and seeing secondly, that there is commonly as much Blood as *Serum* that flows to the Kidneys (the Blood returning back by the Emulgent veins) it is clear that by the two Emulgents (which are none of the largest Arteries) there must pass in half an hours time six pounds of liquor, all which must come from the Heart; and how much more then may we conceive to be driven through all the other Arteries that run through the whole Body. This is more accurately evinced by Dr. *Lower's* experiment, which is this: "I cut asunder (says he) both *Cervical* arteries in a large Dog, and at the same time through an hole made in the left side of his Breast over against the Heart, I compress the trunk of the *Aorta* below the
" Heart

"Heart with my finger, to hinder any Bloud
 "from descending by it; and lastly I took care
 "also to straiten the *Brachial* arteries under the
 "*Axillæ*, by which means almost all the Bloud
 "was driven out of the Heart through the *Cer-*
 "*vicals* (besides that which was sent into the
 "*Verrebrals*) and which is wonderfull to be rela-
 "ted, within the twentieth part of an hour the
 "whole mass issued out; so that it is not to be
 "denied but that it all past through the Heart in
 "that space.] And though it may be granted that
 amidst such wounds and tortures the Heart does
 beat somewhat quicker than at other times; yet
 the same thing is partly evident from wounds in
 the Limbs when some notable Artery is cut a-
 sunder, for 'tis strange in how small a time a Man
 will bleed to death even at that one Artery. Yea
 we may give a great guess how much Bloud is
 sent out at every Pulse, even from the ordinary
 opening of one *Vein* in the Arm, from whence a
 notable quantity of Bloud will issue in a short time;
 how much then may we suppose would flow out
 of all the Veins, if they were opened at one time?
 Seeing then 'tis evident that so great a quantity
 of Bloud is expelled out of the Heart at every *Sys-*
tole, and that for all that the Arteries are not un-
 duly distended nor any part swell'd by it, neither
 yet the *Cava* and other Veins emptied, 'tis cer-
 tain that the Bloud that is driven into the Arte-
 ries flows back to the Heart by the Veins, in a
 constant circulation.

2. A second Argument to prove it, may be ta-
 ken from the Valves in the Veins, which are so
 framed that Bloud may freely flow through them
 out of the lesser Veins into the greater, (and so
 into the *Cava*) but not on the contrary out of
 the

Chap. VI. Of the Pulse and circul. of the Bloud. 271

the greater into the less. Yea if one blow into the *Cava* through a Pipe, there will no wind pass into the smaller Veins; but on the contrary, if you blow up the lesser Veins, the wind will readily pass to the larger and so to the *Cava*.

3. And lastly, The same thing is most clear by the Ligature in blood-letting. For whether you let blood in the Arm or Foot, you always tie the Filler above where you intend to make the Orifice, and then the Vein below the Ligature will presently fill and grow tumid, but above it will fall and almost disappear. Which must needs be from hence, for that the Blood being driven along the Arteries towards the extreme parts, returns by the Veins and ascends upwards, which coming to the Ligature and being stop't there, swells the Vein below the Ligature, and spurs out as soon as the Orifice is made: but when the Filler is loosed again, the Blood flows no longer out thereat, but holds on its wonted channel, the Vein, and the Orifice closes up again.

Having sufficiently demonstrated the circulation of the Blood we will shew two things further, *first*, how the Blood passes out of the Arteries into the Veins, and *secondly* in how long a time the whole mass of Blood may be supposed to pass through the Heart in its ordinary circulation.

As to the *first*, it was the opinion of *Ricohamus* that the Blood circulated onely through the larger Vessels, by anastomosis or inosculation of the Veins with the Arteries; and that that which run into the smaller, was all spent on the nutrition of the parts. But it is clear that there must be a circulation even in the smallest, from the great quantity of Blood that will flow out of the least Artery in the Hand or Foot, when it is cut, which

*How the
Blood pas-
ses out of
the Arte-
ries into
the Veins.*

which it were very absurd to imagine to be all spent on the nourishment of the respective part. Now there are but two ways whereby the Blood can be supposed to pass out of the Arteries into the Veins, *viz.* either by the formers being continued to or opening into the latter by inosculation, or else by the Capillary arteries letting out their Blood into the pores of the substance of the parts, on whose nutrition part is spent, and the remainder imbibed by the gaping mouths of the Capillary veins. That it is necessary to admit of this *latter* way, is evident, because if part of the Arterial blood did not issue into the substance of the parts, they could not be nourished by it; for while it is in the vessels it may add warmth indeed to the parts through which it flows, but cannot nourish them, seeing even the vessels themselves are not nourished by that stream of Blood that glides along their Cavity, but by Capillaries running through their Coats; and if the Blood be driven into the substance of the parts, and that in a greater quantity than suffices for their nourishment (as was just now shewn that it is) what is superfluous must needs enter the mouths of the Capillary veins, from which it goes forward to the larger and so to the Heart: But seeing this way of transfusing the Blood through the substance of the parts has seemed to some not to answer to that hasty circulation of it we above demonstrated; they have thought it necessary also to admit of the *former* way, namely anastomoses, by which the Veins are continued to the Arteries, and that not onely in their larger branches (as that notable one of the Splenick artery with the Splenick vein) but also in their smaller twigs in the extreme parts. But we must
con-

consider, that in a living body the solid parts are infinitely more porous and permeable than in a dead ; so that though the Anatomist find their substance so dense and close, as to make it seem almost impossible they should permit so quick a passage to the bloud through them : yet he should rather believe it, than suppose such anastomoses as he cannot discover, (though it were not difficult to find them out if they had an existence.) For abating that single one of the Splenick Artery with the *Ramus Splenicus* of the *Porta*, (and perhaps some of the *Arteria* with the *Vena pulmonaris* in the Lungs) none of the latest most accurate Anatomists have been able to find out any. And as for that mentioned, it seems rather to be of an Artery with an Artery (such as are frequent in several parts of the body, as are also of one Vein with another) than of an Artery with a Vein ; for the *Porta* from which this *ramus* is propagated, is generally reputed rather an Artery than a Vein, for the reasons alledged in Chap. 12. of Book 1. where we described this vessel.

And *secondly* as to the space of time in which the whole mass of Bloud may ordinarily circulate through the Heart, it is probably much shorter than many have imagined. For supposing that the Heart makes two thousand pulses an hour (which is the least number any speak of, and some have told twice as many) and that at every pulse there is expelled an ounce of Bloud (which we may well suppose, seeing the Ventricles are wide enough to contain two ounces, and that it is probable, both that they are filled near full in the *Diastole*, and that they are near if not quite emptied by the strong constriction of the Heart in the *Systole*) seeing the whole mass usually exceeds

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not

*In what
space of
time the
whole mass
circulates.*

not four and twenty pound, it will be circulated six or seven times over through the Heart in the space of an hour. And by so much the oftener, by how much the Blood comes short of the supposed quantity, or the pulse either naturally, or by a Fever or violent motion is rendred more frequent. By which quick motion the Blood itself is kept from coagulation and putrefaction, and the parts are cherished with vital heat, which heat of the parts is much according to the slowness or rapidness of the circulation; so when we sit still and the pulse is slow or rare, we grow cold, but when upon running or any violent exercise the pulse becomes more frequent and quick, we become hot.

C H A P. VII.

How Blood is made of Chyle, of its Heat and Colour, and whether the Body be nourished by it.

ACcording to Dr. Harvey's observations there appears in an *Embryo* a *punctum saliens*, or red beating speck, which is Blood, before any the least lineament of the Heart. So that whatever instrument of sanguification the Heart may appear to be afterwards, it contributes nothing to the making of the first Blood; but it seems rather to be made for the Blood's sake, to transmit it to all the parts of the *Embryo* or *Fetus*, than the Blood to be made by it. But it must be confessed that things proceed in the grown *Fetus* far otherwise than they do in the first formation. For the parts
of

of an *Embryo* are nourished and increased before it have a stomach to concoct any thing, and yet in a perfect *Fetus* none can deny that the Stomach does concoct and prepare nourishment for it: so it moves before the Brain is formed so perfectly as to be able to elaborate Animal spirits; and yet after it is perfected, every one knows that the Brain does elaborate such spirits, as being sent into all the parts of the Body by the Nerves enable them to move. In like manner though there be Bloud in the *Embryo* before the Heart be formed, yet after it is perfected, nothing will hinder but it may at least contribute something to sanguification.

We will suppose then, that as all the other parts are formed by the *Vis plastica* or generative faculty of the (first) vegetative and (then) animal Soul, seated in the *Ovum*, and receive their first encrease by the assimilation of the *colliquamentum*; but as soon as they are perfected and the *Fetus* excluded, are nourished by the Bloud: so the Bloud it self being at first made in like manner, as soon as the Veins, Heart and Arteries are completed so as it can circulate by them, may, not improperly, be said to be nourished by the Chyle or nutritious juice, the Heart assisting the assimilation of the one into the other. And this is done in this manner. The Chyle ascending

How chyle is turned into bloud.

by the *Ductus thoracicus* (as was described Book 1. Chap. 10.) and flowing into the Subclavian vein, together with the returning venal Bloud is poured by the *Vena cava* into the right auricle, & so into the right ventricle of the Heart in its *Diastole* or Relaxation; then by its *Systole* or Contraction it is driven out from thence into the Lungs, from whence it ascends again into the

left auricle first and then into the left ventricle of the Heart, out of which it is expelled through the *Aorta*, and passing along with the Blood through the Arteries of the whole Body, returns again with it by the Veins to the Heart. For it undergoes many circulations before it can be assimilated to the Blood. Which is evident, both because it is the Chyle (but little alter'd) that is separated in the *Placenta uteri* for the nourishment of the *Fetus*, and in the Breasts for the Infant to suck, in the form of Milk; and also from hence, that if one be let blood four or five hours (or later) after a full meal, there will a great quantity of the milky Chyle it self swim atop the coagulated Blood. But every time the new infused Chyle passes through the Heart with the Blood, the particles of the one are more intimately mixed with those of the other in its Ventricles, and the vital spirit and other active principles of the blood work upon the Chyle; which being full of salt, sulphur and spirit, as soon as its *Compages* is loosened by its fermentation with the Blood in the ventricles of the Heart (especially, but also in the Arteries) the principles having obtained the liberty of motion do readily associate themselves; and are assimilated with such parts of the Blood as are of a like and suitable nature; so that at length all the mass of Chyle that is capable of being turned into blood, is sanguified; and what is not, is evacuated by urine, or stool, or other proper Emunctory.

How the
blood be-
comes hot.

It is a very difficult question, by what means the blood acquires its heat. In order to the resolution whereof it will be necessary to consider how many ways a liquid body is capable of being heated,

ted, and those (according to Dr. Willis) are three. " *First*, by setting it to something that is " hot ; so water is made hot by being set on the " fire, or in the sun or a stove, or by dissolving " lime in it. " *Secondly*, when saline corrosives, " which are of a contrary nature, being mixt " with one another, or with sulphureous, act one " on another, and by the great strugling and agi- " tation of their particles do often excite heat, " yea sometimes smoke and burning ; as when " spirit, and butter of Antimony, or when *aqua* " *stygia* and oil of turpentine are mixed together ; " also when corrosive liquors eat into metallick " bodies, they often grow hot. " *Thirdly*, (which " is the onely way besides that a liquid grows " hot) when some humour abounding with sul- " phur or much spirit is set on fire by holding a " flame to it, and so grows hot by deflagration, " as Brandy, &c. There are other ways indeed " of calefaction, as *fermentation*, *putrefaction* and " *attrition*, whereby *thicker* or *solid bodies* often " grow hot, but in *liquid* they produce no such " effect. Thus Leaven becomes (somewhat) hot " by *fermentation*, and dung or wet hay by *putre-* " *faction* ; but neither way will a *liquid body* wax " hot : for though Wine, Cider, &c. ferment so " much as to burst the sides of the Hogs-head, " yet they are not actually hot ; nor will bloud " become so, when it is let out of the body, dis- " pose it how you will in fit glasses to ferment or " putrefie. Indeed the bloud within the body is " fermented, and is thereby depurated, but it is " not heated by such fermentation, as neither is " any other liquid. Neither does the heating by " *attrition* agree to it ; for though *solid bodies* are " heated by being rubb'd one against another ;

“yet shake and agitate Liquids as much as you
 “will, they shall be never the warmer for it.
 “Therefore seeing there are onely those three
 “ways first mentioned whereby actual heat can
 “be produced in any liquors, let us see to which
 “of them the incallescence of the blood ought to
 “be ascribed.

“*First*, both the Ancients and some Moderns
 “are of opinion, that the blood is heated the first
 “way, *viz.* by the admotion of something that
 “is hot. Thus the former have taught that the
 “*innate heat*, and the latter that the *vital flame* is
 “lodged in the heart, and heats the blood as it
 “passes through it: But both these opinions fall
 “to the ground, since it is clear that the heart is
 “a *mere muscle* and contains no fit fuel for per-
 “petuating a flame, or I know not what implan-
 “ted heat: For though it must be acknowledged
 “that the circulation of the blood depends on the
 “continual motion of this bowell, yet the *heart*
 “derives its heat wholly from the *blood*, and not
 “the *blood* its from the *heart*.

“*Secondly*, this heat cannot be caused in the
 “blood the second way, because its liquor in a
 “natural state is always homogeneous; and
 “though it abound with salt, yet that is onely
 “volatile, mild and benign. Nor can any one
 “discover either in the *heart*, or in any other *fo-*
 “*cus* a saline or otherwise heterogeneous mineral,
 “by acting whereupon or corroding whereof the
 “sanguineous liquor should conceive heat. —

“*Thirdly*, as to the third way, whereby liquids
 “grow hot, though it seem an hard saying, that
 “*the blood is accended*; yet seeing we can attribute
 “its incallescence to no other cause, why should
 “we not impute it to this? especially seeing the
 proper

"proper passions of fire and flame agree to the life of the bloud.

"For the chief and most essential Requisites to continue a flame are these three, *first*, that a free and continual access of air be granted to it as soon as it is kindled; *secondly*, that it enjoy a constant sulphureous *pabulum* or fuel; and *thirdly*, that as well its fuliginous, as thicker recrements be continually amended from it: And seeing these agree to the *vital flame* as well as to an elementary, it seems very rational to affirm that *life it self is a kind of flame.*] Thus far that learned Author, whom the Latin Reader will do well to consult discoursing further on this subject in his *Exercit. medico-physica de sang. incalescentia sive accensione.*

Dr. *Henshaw* thinks that "the dissimilitude of parts between the chyle and bloud is so great, that it becomes immediately the cause of an extraordinary ebullition upon their mixture together; which is very much increased by the reciprocal motion of the Lungs, whereby the bloud is wrought almost into a froth or foam by that time it gets into the left ventricle of the heart. Which sudden excess of heat, is not unlike what happens upon the mingling several Chymical liquors together, as spirit of *Wine* and spirit of *Turpentine*, and other such like, where the heat becomes so great, that it often endangers the vessels they are contained in. He affirms (contrary to Dr. *Willis*, and I think to the truth) that "new *Wine* or *Must* while it ferments is hot; and that if juice newly pressed out of the grapes were added to it as it begins to cool, it would again renew its ebullition, and its warmth would be continued so long as one should

“ should persist to do so: In like manner he thinks
 “ is the warmth in the blood continued by the
 “ new affusion of chyle, which renews its fermentation,
 “ and consequently invigorates its heat.

Diemerbroeck is of opinion, that “ the *vital spirit*
 “ (by which he understands the more subtle
 “ part of the blood) while through its great
 “ volatility it always endeavours to fly away, does
 “ continually agitate the other thicker particles
 “ of the blood, with which it is intangled and
 “ detained from flight, and is diversly vibrated
 “ by them, and bear back; and so the whole
 “ mass being kept in a continual fermentative
 “ motion, there is produced in it an heat, which
 “ in a great agitation is great, in a mean, mean,
 “ and in a small, small.

I might cite other opinions concerning the reason of this *heat*, but they generally fall in with some of these mentioned: of which I shall not make my self an Umpire, but think that *Dr. Willis* has said enough to evince that it is not caused either of these latter ways, *viz.* by fermentation, or by agitation of the particles of the blood in the manner *Diemerbroeck* describes it; and whether the accension of the blood be a more probable reason of it, let the Reader judge.

The colour
 of the
 blood.

Why the Blood should be of a *red colour* rather than any other, no satisfactory reason (I think) can be given but the will of the Creatour, though some attribute it to the Heart, others to the mixture of salt and subacid juices with sulphureous, because from such a mixture there results a red colour, as appears in the distillation of *Sal nitre*, (which contains many sulphureous particles in it;) or by the pouring Oil of *Vitriol* upon *Conserve*

serve of Roses, or other thing that is of a palish red (if it contain any thing of sulphur) for it will be thereby made of a most deep red. We will not spend time to shew in how many respects these instances differ from the *Phænomenon* under consideration, but shall content our selves with inquiring from whence the difference of colour arises between the Venal and Arterial blood. Every one knows that when Blood is let out of a Vein into a Porringer, the *coagulum* is of a florid scarlet colour in its surface, but of a dark red from the superficies to the bottom, and of such a colour it appears as it streams out of the Orifice of the Vein. But if an Artery be cut, the stream then looks of a far brighter colour, like the superficies of the Venal blood when it is coagulated in a Porringer. Now the Arterial blood receives not this florid colour in the Heart but in the Lungs. For if it receiv'd it in the Heart, then might the right Ventricle be supposed to give it as well as the left: but that it does not do so, is clear by this experiment of Dr. Lower's. If you open the *Vena arteriosa* which receives the Blood out of the right Ventricle, the Blood differs nothing in colour from the Venal, but its curdled part looks every whit as black. But if one open the *Arteria venosa* as it is entring into the left Ventricle, it has the perfect colour of Arterial blood; which shews, that as it owes not that colour to the left Ventricle any more than to the right, (being not yet arriv'd at it) so it must receive that alteration of colour in the Lungs, in which the nitrous air being diffused through all the particles of the Blood is intimately mixed with it, and (if you will) accends it. For if there be any such thing as a *Flamma vitalis* (properly so called) in Animals,

Animals, though the Blood (or Chyle rather) be to it instead of the Oil or other matter whereon it feeds, yet it oweth the continuance of its burning to the Air, without the continued inspiration of which the Animal cannot live, but instantly dies, even as a Candle is presently extinguished if you put it in a close place where the air cannot come to it, or by some Engine be sucked from it. But this by the bye. For I must confess that (how plausible soever this opinion may seem on other accounts) this alteration of the colour of the Blood by the Air in the Lungs, is no sufficient argument to prove any such vital flame, seeing the Arterial blood being extravasated, retains its florid colour, when no doubt if there ever was any accension, the flame is extinguished. But this scarlet colour is owing meerly to the mixture of the particles of the Air with the Blood in the Lungs, from which it transpires, in a great measure, through the pores of the Skin, while the Blood circulates in the habit of the Body out of the Arteries into the Veins, whence the Venous blood becomes so much darker in colour than the Arterial. And yet the Venous blood it self when extravasated appears of a scarlet dye in its surface, which is merely from its being exposed to the Air; for if one turn the congealed Blood in a Porringer upside down, the bottom which at the turning is blackish, will in a little while turn red.

*Whether
the body be
nourish'd
by blood.*

Though we have confessed that the Chyle does circulate through the Body several times before it be perfectly assimilated to the Blood; yet we do not think that it passes into the nourishment of the parts in the form of Chyle. And therefore
when

when speaking of the nutrition of the *Fetus* in the Womb (Book 1. Chap. 33.) we often mentioned a *nutritious juice* (which was Chyle a little alter'd) we did not call it so with respect to the solid parts of the *Fetus*, but to the Bloud it self whose *Pabulum* or nourishment it is, as soon as the Umbilical vein is formed, as the Bloud is of the Body. For as to the increase of the first delineated parts of an imperfect *Embryo*, that is far different from ordinary nutrition.

The Bloud then consisting of particles of a different nature, each particle passes into the nourishment of that part which is of the same nature with it. So the salt and sulphureous particles being equally mixt, are agglutinated and assimilated to the fleshy or musculous parts; the oily and sulphureous to the Fat; the salt and tartareous to the Bones, &c. Now this is not done by any election or attraction of the parts, as if they pick'd and choos'd (with a kind of discretion) such particles of the Bloud as are suitable to their own nature; for the mass of Bloud is equally and indifferently carried to all the parts: But there is that diversity of figure both in the several particles of the Bloud and in the pores of each part, that in the circulation through the habit of the Body some stick in these, and others in those, where they are fasten'd and united to the substance of the respective parts; and those which through their peculiar figure are unapt to adhere to one or other, return again to the Veins and so to the Heart, where they receive some new alteration. So that as *the life of the Flesh is in the Bloud* (according to *Levit. 17. 11.*) so has it its vital heat and nourishment from it also,

C H A P. VIII.

Of the parts of the Heart, viz. the Auriculæ, the Ventracles and the Septum that divideth them.

HAVING treated of the Heart in general, and of its *Action*, &c. we now come to discourse of the *parts* which it consists of, viz. its two *Auriculæ*, two *Ventracles* and the *Septum*.

Auriculæ.

The *Auriculæ* or *Ears* of the Heart are so called from some similitude of shape they have with those of the Head; for they rise from a long basis, upon the basis of the Heart, and end in an obtuse point, making an obtuse triangle. They are as it were two appendages of the Heart, seated at its basis over the *Ventracles*. They are of the same fabrick and use, being both *Muscles*, and made up of the same order of *Fibres*, which are carried into opposite *Tendons*, whereof that at the basis of the Heart is common to it and these *Auriculæ*, and the other runs along their upper part. The right is larger and softer, the left is less, but more firm. Their superficies is smooth when they are filled; but when empty, it is wrinkled, and the left more than the right. When they are cut open, there appear in their Cavity many fleshy columns running from the upper to the lower Tendon, and betwixt them there are pretty deep Ditches or long Cavities, but fewer in the right than the left.

Their motion.

They are dilated and contracted in like manner as the Heart, but at different times: for the *Systole* of the *Ventracles* is at the same time with the

the *Diastole* of the *Auriculæ*, and on the contrary, the *Systole* of the *Auriculæ* with the *Diastole* of the Ventricles. So that the *Auriculæ* are a receiving their Blood from the Veins, while the Ventricles are expelling theirs into the Arteries; and when the Ventricles are relaxed and empty in their *Diastole*, the Auricles force their Blood into them by their *Systole*.

They serve to receive the Venal blood immediately out of the *Vena cava*, and *Pulmonalis*, and to measure it, as it were, into the Ventricles. Whither that they may expell it with the greater force, the internal Fibres or Columns of their cavity arising from their root where they are joined to the basis of the Heart, reach directly outwards towards the *Vena Cava*, and *Pulmonaris*, and in the *Systole* of the *Auriculæ* grasp the Blood contained in their cavity like so many fingers, and squeeze it into the Ventricles whilst they are relaxed in their *Diastole*. Use.

The Heart hath two Cavities, called *Ventricles*, The Ventricles. whereinto it receives the Blood from its two Auricles, and out of which it expells it into the *Arteria pulmonaris* and *Aorta*. They are not altogether like one another; for the right is wider, and in shape almost semicircular, nor reacheth it down to the *Mucro* or tip of the Heart; whereas the left is almost round, and reacheth down to the very tip. Now though the outside of the Heart be smooth, yet these Ventricles are very unequal, having their sides hollowed into divers interstices or furrows, and interwoven with carnous Fibres reaching this way and that way. They are more numerous in Mens Hearts, than in those of any other Animal; though such as are

are big, as Horses and the like, have them larger. These Fibres or fleshy Columns serve to straiten or constrict the Ventricles, and the clefts or furrows betwixt them help their sides to close more exactly in their *Systole* than they could have done, had they been smooth. The Fibres are more and stronger and the furrows deeper in the left Ventricle than in the right, yea they are also in that side of the *Septum* that makes part of the left, though that side that looks to the right be well-nigh smooth. For there was need of greater and stronger constriction in the left than in the right; seeing the right expells the Blood to no greater circuit than through the Lungs, but the left to the extremest parts of the Body.

Septum.

They are divided from one another by the *Septum*, which is a carnous and dense partition that stands like a Wall betwixt them. It is hollow towards the left Ventricle, and (as was just now said) has such like Fibres and Clefts as the rest of the Cavity; but towards the right it is convex or bunching out, and has but very little inequality. Many have been of opinion that it has some wider pores through which part of the Blood does pass immediately out of the right into the left Ventricle; but he that searches for them diligently will find none, unless he first make them with his Probe. And indeed if there were any in grown persons, we may much more suppose them to be in *Fetus's* in the Womb, in whom are several passages that after the birth are obliterated. But if these were in the *Fetus*, then should Nature have made those two other passages in vain, namely the *Foramen ovale*, whereby the Blood passes out of the *Cava* into the *Vena pulmonaris* as it is entring the left Ventricle; and the *Canalis arteriosus*,

arteriosus, which carries the Blood out of the *Arteria pulmonaris* into the *Aorta*. I say if the Blood could have passed out of one Ventricle into the other (without going through the Lungs) by any pores that perforate the *Septum*, these other passages had been superfluous. And therefore we may suppose, that as in grown persons they cannot be found by any Probe or Bristle, so they were not there even while the *Fetus* was in the Womb, seeing there was no occasion for them.

As to the use of the Ventricles, it may be learned partly by what has been discoursed in the three former Chapters, and partly by what shall be said further in the following, wherein we are to describe the Vessels opening into and out of them. Whither also we transfer the treating of their *Valves* that are placed at their Orifices.

C H A P. IX.

Of the Ascending trunk of Vena Cava.

BECAUSE the Vessels contained in the *Thorax* either open into the Heart or run out of it, having finished the description of *it*, we shall discourse next of *them* as appendages to it. But waving the repetition of what we discoursed Book 1. Chap. 10. of the *Ductus chyliferus thoracicus*, that runs up the *Thorax* by the Spine, and opens into the Subclavian vein, and referring the Reader thither for the description of that vessel; I shall here onely meddle with the Sanguiferous vessels

vessels that are four in number, viz. *Vena cava*, *Vena arteriosa* (or *Arteria pulmonaris*) *Arteria venosa* (or *Vena pulmonaria*) and the *Aorta* or *Arteria magna*; and in this Chapter of the first, viz. *Vena cava*.

*Vena ca-
va.*

In the former Book Chap. 12. and 13. where we discoursed of the Vessels contained in the *Abdomen*, we supposed (with the Galenists) that both the *Vena portæ* and *Cava* had their rise from the Liver, not dogmatically asserting it, but supposing it for methods sake. And in Chap. 13. describing the branches of the *Cava* in the *Abdomen*, we found it presently dividing it self (after its rise out of the upper part of the Liver) into the *Ascending* and *Descending* trunk; the description of the branches of the latter (in the lower Belly) we there finished; but traced the *Ascending* trunk no further than its penetrating through the Midriff up into the *Thorax*, deferring the further prosecution of it till this place that we come to treat of the Vessels contained in the *Thorax*.

*Venæ
phrenicæ.*

As it ascends through the Midriff it sends forth a small sprig on each side, called *Venæ Phrenicæ*; these run through the Midriff, the *Mediastinum* and *Pericardium*. If at any time matter gathered in the cavity of the *Thorax* be afterwards discharged by Urine, (which many Physicians have affirmed) it is probable that it is absorbed by the mouths of these Veins gaping in the upper side of the Diaphragm, (upon which such matter must be supposed to fluctuate) whereby it is brought into the *Cava*, and so in the circulation is separated by the Kidneys out of the Emulgent arteries, and descends by the Ureters to the Bladder.

*Venæ co-
ronariæ.*

From the Diaphragm it passes undivided to the right Auricle of the Heart, but before it enter it,

Chap. IX. Of the ascending trunk of Vena cava. 289

it, having pierced the *Pericardium* it sends forth sometimes one, sometimes two twigs called *Venae coronariae*, which compassing the *basis* of the Heart bring back into the *Cava* the Blood that is superfluous from its nutrition. As these open into the *Cava* there is a Valve placed, which permits the Blood to return by them into the *Cava*, but hinders any to pass out of the *Cava* into them.

Before this trunk of *Vena cava* open into the Auricle it is joined to that other trunk that descends from the *Clavicula*, (though for method's sake we must consider *that* as a continuation of *this*, by and by) and both of them discharge the Blood contained in them by one mouth first into the Auricle and then into the Ventricle of the Heart. As they are going to join, there comes a Tubercle or Protuberance betwixt them, that hinders the one from opening into the other in a direct line, but makes them both go obliquely towards the left hand as they enter the *Auricula*; without which provision, that Blood that is a descending from the *Clavicula* would have fallen so full on that which is ascending by this trunk of the *Cava*, we have been a describing, as must have made it either to stagnate (if not regurgitate) or however would have retarded its motion.

Now immediately below this protuberance, out of the united trunk there goeth a passage along the *basis* of the Heart to the *Vena pulmonaria* in *Fetus* in the Womb, which as soon as they are born closes up and is obliterated. The reason of this passage of the Blood in them is, because their Lungs having either none or but a very obscure and imperfect motion, the Blood does

but little of it pass through them, but a good part of it through this *Foramen* out of the *Cava* into the *Vena Pulmonaria* just as it is entering into the left Auricle, through which this Blood is discharged into the left Ventricle together with that little that is returning by the said *Vena pulmonaria* from the nutrition of the Lungs. For though there be expelled out of the right Ventricle a pretty quantity of Blood at every pulse into the *Arteria pulmonaris*, yet there is but a little of it that goes to the Lungs (though all do in adult persons, that it may be there impregnated with Air) but the greatest part by a Pipe called *Canalis arteriosus* runs into the *Aorta*, which Pipe does degenerate into a Ligament after the *Fetus* is born. So that the *Fetus* in the Womb liveth after the manner of Fish or other Creatures that have no Lungs and but one ventricle of the Heart; for there is but very little of its Blood that passeth any more than one of its Ventricles in one circulation, that which circulateth through one missing the other. But to return:

The united trunk of the *Cava* opens by one large Orifice into the right ventricle of the Heart, into which is poured all the Blood that returns from all the parts of the Body (except the Lungs) in its circulation. And lest in the *Systole* or contraction of the Heart, the Blood should be expelled the same way it comes in; at the Orifice of the *Cava* there grows a membranous circle, which is cleft into three membranous *Valves*, looking inwards, called *Tricuspidæ* (or three-pointed) which permit the Blood to come in, but not to go out. And this office these Valves perform in this manner, (as is most ingeniously described by Dr. Lower.) Out of the sides of the right Ventricle there grow

*Valvulae
tricuspides.*

grow certain *Papillæ* or round and long Caruncles (called before, fleshy Columns) from whose top there proceed certain tendinous Fibres that are knit to these Membranous Valves. Now these Membranes encompass the orifice of the *Cava* round about, so that whereas the *Macro* or tip of the Heart is in every *Systole* drawn up towards the *basis*, the *Papillæ* being also moved upwards do slacken their Fibres (like Bridle-reins) whereby it comes to pass that the Membranes (or Valves) also, to which they are tied, hanging loose are driven upwards (like sails filled with wind) by the Blood that is squeezed in every *Systole* of the Heart, and thereby they shut this inlet into the Heart so closely, that not a drop of liquor can flow back again into the *Auricula* or *Cava*, but is expelled all into the *Arteria pulmonaris* whose orifice is now open: But, as in every *Systole* of the Heart (its tip being brought nearer its *basis*) the *Papillæ* do much relax their Fibres; so in the *Diastole* the tip receding from the *basis* again, does also draw down the *Papillæ* and their Fibres with it: whence it comes to pass that the Membranes or Valves being also drawn down do presently uncloseth this Orifice, and open the door as it were for more Blood to come in, what came in before being expelled in the last *Systole*.

The two Trunks of the *Cava* having thus discharged themselves by one orifice into the right Ventricle, that Trunk which ascends towards the *Clavicula* (for so we must consider it for orders sake, though in truth it descends from thence) as soon as it is gone out of the *Pericardium*, sendeth forth a notable branch called *Vena sine pari*, (or *venæ cavae sine pari*) because it is but one, having no fellow.

It ariseth out of the hinder part of the *Cava*, *Vena sine pari*.

but more towards the right hand, and descends through the right side of the cavity of the *Thorax*. After its rise, which is betwixt the fourth and fifth *vertebra* of the Breast, it bends a little forward toward the right hand, till it be descended as far as the eighth or ninth *vertebra*, where it begins just to keep the middle. It sends forth on each side Intercoastal branches to the Interstices of the eight lowest Ribs; and at the eighth Rib it is divided into two branches: One whereof, being the larger, descends toward the *left hand* betwixt the processes of the Diaphragm, and is inserted sometimes into the *Cava* above or below the Emulgent, but oftener into the Emulgent it self: The other being the *right* is joined also to the *Cava*, commonly a little above the Emulgent, but seldom into the Emulgent it self.

How pus
collected in
the Tho-
rax is
voided by
urine.

It was formerly held, before the circulation of the Bloud was found out, that in an *Empyema* of the *Thorax*, the matter was absorbed by the mouths of this Vein, and carried directly to the Emulgent Veins, where it was separated with the *Serum* by the Kidneys. But seeing the Bloud does indeed ascend from the Emulgents by this Vein, and that at its insertion into them there is commonly a Valve that hinders any thing from issuing out of the *Vena sine pari* into the Emulgent, but permits the contrary; it is certain that if this Vein be at any time an instrument to evacuate such *Pus*, it must first ascend to the *Cava* and pass through the Heart, and so be carried to the Kidneys by the *Aorta* and the Emulgent arteries arising out of it. But though it is difficult to conceive how the mouths of this Vein should open so wide into the cavity of the *Thorax*, as to imbibe slimy ropy *Pus*, and yet not let forth the Bloud that

that is more fluid; so that one would hardly assign this office to it: yet when the *Pus* is collected betwixt the *Pleura* and Intercoſtal muſcles and the Tumour does not burſt, I ſee not why it may not be ſuppoſed that the Intercoſtal branches of the *Vena ſine pari* do imbibe the matter out of the Tumour, and carry it that way which was juſt now ſpoken of. And if ever *Pus* be imbibed out of the cavity of the *Thorax*, becauſe it floats upon the Diaphragm, the *Venæ phrenicæ* are liker to do it than this, as was noted before in this Chapter when we deſcribed thoſe Veins. But the truth is, 'tis more probable, when ſuch matter is voided by urine, that it is abſorbed by neither of theſe veſſels, nor from the places mentioned, but rather by the *Vena pulmonaria* out of the Lungs when they apoſtemate,

Of this *Vena ſine pari* we ſhall ſay no more, but that at its riſe out of the *Cava* it has a Valve that opens towards the *Cava*, which having ſent forth this Vein, aſcends on towards the *Clavicule* ſtrengthened and ſuſtained by the *Mediaſtinum* and *Thymus*, and before it is divided into the two *Rami ſubclavii* (ſometimes after) ſends out yet two other ſmall Veins called

The ſuperiour Intercoſtals, on each ſide one, each of which has a Valve where it joins to the *Cava*, permitting the influx of the Blood into the *Cava*, but hindring its relapſe. Theſe run along the Interſtices or intervals of the three or four uppermoſt Ribs. Yet ſometimes the *Vena ſine pari* ſends twigs to theſe four Interſtices of the Ribs as well as to the eight lower, and then theſe ſuperiour Intercoſtals are wanting.

Afterwards the trunk of the *Cava* is divided into two large Veins, one of which goes to the

Intercoſtals ſuperiores.

Intercoſtals ſuperiores.

Intercoſtals ſuperiores.

Venæ ſubclaviæ.

right hand, the other to the left. These, while they are within the Breast, are called *Vena subclavia*, running along the under side of the *Clavicula*; but as soon as they are gone out of it, *Axillares*. They send forth several branches both upwards and downwards. Sometimes the superior Intercostals just now mentioned (though seldom) arise out of them. Next, the

Branches
arising
from them.
1. Mam-
mariae.

Mammariae descend from them, (though these sometimes spring out of the trunk of the *Cava*; so uncertain is the origine of some of these Veins.) These send forth double branches, Internal and External. The *Internal* run to the gristly ends of the Ribs and their Intercostal spaces, and some of their twigs also are terminated in the glands of the *Mammae*. The *External* pass down on the outside of the Breast, and send many twigs into the said Glands, and marching further by the sides of the *Cartilago ensiformis* descend out of the *Thorax*, continuing their course down the *Abdomen*, under the streight Muscles thereof, till about the Navel, where it hath been an old Tradition that they inosculate with the *Vena epigastrica*; but this was a mistake, as has been noted more than once already. *Bartholin* says that sometimes there is but one *Mammaria*.

2. Media-
stina.

The second Vein that riseth out of the Subclavian is the *Mediastina*; this sends twigs to the *Mediastinum* (from which it has its name) to the *Pericardium* and to the Gland called *Thymus*. This also sometimes springeth out of the trunk of the *Cava*.

3. Cerci-
calia.

The third is *Cervicalis* or *Vertebralis*; this turns backwards towards the *vertebrae* of the Neck, into whose lateral holes it enters by some small twigs, which disperse themselves through the Mem-

Membrane that invests the marrow contained in these *Vertebrae*; and other twigs it bestows upon the Muscles that lie next upon the *Vertebrae*.

The fourth is *Muscula inferior*; this is spent upon the lower Muscles of the Neck and the upper of the *Thorax*. It riseth sometimes from the external Jugular. 4. Muscula inferior.

All these spring from the lower side of the Subclavian veins; but these that follow from the upper. As

The *Muscula superior*, which is dispersed through the Muscles of the Neck. 5. Muscula superior.

Then the *Jugulars*, which are double, *External* and *Internal*. As these go out of the Subclavians there is placed sometimes one thin Valve, sometimes two, to hinder the return of the Blood out of the Subclavians into them. 6. Jugulares.

The *External* ascend on the outside of the Neck, and these are they which are opened when one is let blood in the Neck for any Distemper of the Head, or Quinzy, &c. They ascend but just under the Skin, and provide for the outward parts of the Neck, Chaps, Head and Face. They make the Temple-veins and the Forehead-vein, both which are wont sometimes to be opened. Yea they send small Capillaries through the sutures of the Skull into the Membranes that cover the Brain.

The *Internal*, in Men, are larger than the *External*. They ascend from the Subclavian by the sides of the Wind-pipe, on which they bestow small twigs. As soon as they are come to the basis of the Skull, they are each divided into two, the greater and less. The greater is carried backwards, and by that hole of the *Os occipitis* by which the sixth pair of Nerves (Dr. Willis's eighth)

eighth) comes out of the Head, they enter in, and are dispersed through the *Dura mater*, &c. The less enters in by the holes made for the third and fourth pair of Nerves, and is also bestowed on the *Dura mater*, &c.

When the Subclavian veins have sent forth all these branches, they then pass out of the *Thorax*, and begin to be called *Axillar*, of which we shall treat in the fourth Book, Chap. I.

Into the *Vena subclavia* are inserted also the *Ductus chyloferus thoracicus* (of which in the first Book Chap. 10.) and *Lymphaticus ramus*, which returns the *Lympha* from the Arms, Neck, &c. but sometimes this opens into the Jugular.

CHAP. X.

Of *Vena arteriosa*, and *Arteria venosa*.

Vena arteriosa.

THE second vessel in the Breast is commonly called *Vena arteriosa*, but more properly *Arteria pulmonaris*, both because it performeth the office of an Artery, in carrying Blood out of the right Ventricle of the Heart to the Lungs; and also because its Coat is double like that of other Arteries.

Its valves.

As it riseth out of the right ventricle of the Heart, there stand at its orifice three Membranous *Valves* looking outwards, called *Semilunares*, because they make as it were a half circle; as also *Sigmoides* or *Sigmoideæ*, from the shape of the Greek letter *Sigma*, which of old was of the same figure with an English capital C. In the
Systole

Systole of the Heart they open, and permit the Blood to issue out of the Ventricle into this Artery; but in the *Diastole* they shut, so that none can return back again.

As soon as it is past out of the *Pericardium*, it bends towards the *Aspera arteria* or Wind-pipe, and is divided into the right and left branch, which applying themselves to the like branches of the *Aspera arteria* do every where accompany them on the under side, and as they run along send out very many twigs on every side, which presently associate with those of the Wind pipe, and of the *Vena pulmonaris*. And where the small Pipes of the *Aspera arteria* end into the little round Cells (which we shall describe in the Chapter of the Lungs) the twigs of this Artery being interwoven with those of the Vein do embrace them like a Net. Whence one may guess that the reason why the sanguiferous vessels do so exactly accompany all the branches of the Wind-pipe and its annexed little Bladders, is, that the whole mass of Blood passing this way may be inspired or impregnated with the particles of the nitrous Air. For there is but a very little spent on the nutrition of the Lungs, but the greatest part of it is received by the small twigs of the *Vena pulmonaria* which accompany those of this Artery in all its ramifications.

The third vessel is called *Arteria venosa*, otherwise *Vena pulmonaria*; this has but a single Coat as the other Veins have. After it has accompanied the Wind-pipe and *Arteria pulmonaris* in all their branchings in the Lungs, and by its small twigs has received the Blood (by *anastomoses* as most affirm) out of the Artery, all these twigs are

are united first into two trunks (*viz.* the right and left) afterwards into one, which opens into the left ventricle of the Heart.

Its valves. At its orifice there are placed two membranous Valves called *Mitral*es, because when they are joined together they do in some manner resemble a Bishop's Mitre. They are of a stronger texture than those called *Tricuspid*es at the orifice of the *Cava* in the right Ventricle; and so are the Fibres, that ascend to them from the *Papillæ* or fleshy columns, stronger. For seeing the Blood is expelled more impetuously out of the left Ventricle than out of the right, (for the Blood sent out of the one is to circulate onely through the Lungs, but that out of the other, through the whole Body) it was convenient that the Valves and Fibres should be stronger, to sustain the violent motion of the Blood, and hindring it from returning into this Vein again, to direct its course into the *Aorta* whose orifice opens in the *Systole* of the Ventricle.

Just as this *Vena pulmonaria* is entring into the left Auricle, there is, in a *Fetus* in the Womb, a Pipe called *Foramen ovale* that opens into it coming from the *Cava*, as was noted above. To which we shall here add, that at its orifice into this Vein there is a Valve placed, that hinders any Blood from returning into the *Foramen* out of the Vein.

And here there is onething worth noting concerning the pulmonary Artery and Vein, that whereas in all the other Arteries and Veins through the whole Body besides, the Blood contained in the Arteries is of a bright scarlet colour, and that in the Veins of a black purple; on the contrary, the *Arteria pulmonaris* containeth black purple

purple Blood, and the Vein scarlet-coloured. The reason whereof was shewn before, Chap. 7. viz. That the scarlet colour of the Blood is wholly owing to the mixture of Air with it in the Lungs. And therefore that Blood which the pulmonary Artery brings into the Lungs out of the right ventricle of the Heart, being the Venal blood that was brought thither from the circulation by the *Cava*, changes not its colour till it passes out of the small twigs of the said Artery into those of the pulmonary Vein, where the airy particles insinuate themselves into it, and so alter its colour.

The pulmonary Vein hath no Valve in it, except that at its opening into the left Ventricle. Of which Dr. *Willis* giveth this reason, That the Blood within the *Præcordia* may always, because of the *Impetus* of the passions, freely fluctuate and regurgitate both ways, backwards and forwards. And lest the left ventricle of the Heart should at any time be suffocated by the Blood rushing too imperiously into it, the fleshy Fibres in the root of the Vein (for both this and the *Cava* have such there, which seem to make a kind of Sphincter) by the instinct of Nature contracting themselves invert its course, and make it flow backward towards the Lungs.

CHAP.

CHAP. XI.

Of the Aorta, or great Artery.

Aorta.

THE fourth vessel is the great Artery called *Aorta* (*arcula*, a little Chest) and by way of eminency *Arteria magna*, because it is the greatest Artery of the whole Body, from which all the others (except the pulmonary) are derived.

Its valves.

It springeth out of the left ventricle of the Heart, and at its rise hath three *Valves* looking outwards, called *Semilunares*, being altogether like those at the orifice of the *Arteria pulmonaris* in the right Ventricle. These hinder the Blood from returning out of the great Artery into the Heart again. The orifice of the *Aorta* (or else the Tendon of the Heart that adheres to it) in some Creatures (especially in Harts) does often grow bony; and sometimes in Men, according to the observations of *Bartholin* and *Riolanus*.

As soon as the *Aorta* is gone out of the Heart, it ascends not in a direct course towards the Head; for if it had, seeing it openeth straight upward out of the Ventricle, it would have poured the Blood in too rapid a stream into the Brain, and the lower parts of the Body would have been defrauded of their due share: but it first bends arch-wise, so that its bowed corner sustains the first *Impetus* of the expelled Blood, and directs the greatest torrent towards its descending trunk, and a lesser quantity passes up by the ascending, being to convey the Arterial blood to fewer and smaller parts.

In

In a *Fetus* in the Womb there comes a Pipe out of the *Arteria pulmonaris* into the *Aorta*, called *Canalis arteriosus*, which brings out of it the greatest part of the Blood that was expelled out of the right Ventricle; little more passing into the Lungs than may serve for their nourishment: of which we gave the reason before, Chap. 9. After the *Fetus* is born, the *Canalis* degenerates into an impervious Ligament.

Before the *Aorta* come out of the *Pericardium*, it sendeth forth sometimes one, but oftener two small Arteries, from each side one, which compass the *basis* of the Heart like a Garland, in their circuit sending down divers twigs length-ways of the Heart: They are called *Coronariae*. When these two small Arteries have incompassed the *basis* and meet, they inosculate with one another, but not with the Veins. At their rise out of the *Aorta* there is a Valve placed, that permits the Blood to flow out of the great Artery into them, but hinders its reflux.

When it hath pierced the *Pericardium*, and bended a little arch-wise backwards, it is divided into two Trunks, whereof the one is called *Truncus ascendens*, the ascending Trunk; the other *descendens*, the descending.

Of these two, the *descending* is largest, because it ministreth to more parts.

The *ascending* Trunk running up under the *Vena cava* lies upon the Wind-pipe, and presently sendeth forth two large branches, whereof one passeth to the right, the other towards the left Arm: They are called *Rami subclavii*, because they march under the *Claviculae*; and as soon as they are gone out of the Breast, are called *Axill-*

The division of the Aorta into the ascending and descending trunk.

The branches of the trunk ascending. I. Subclavia.

Axillares. The right is the larger, and rising higher goes a more direct way towards the Arm; the left is less, and rising lower ascends more obliquely towards the left Arm. They send out several branches both from their *lower* and *upper* side.

2. Inter-
costalis
superior.

From the *lower* proceeds the *superiour Intercoſtal*, which runs along the interstices or intervals of the four uppermost Ribs, and sends slips to the neighbouring Muscles and spinal marrow. These sometimes are propagated from the cervical Arteries, coming out through the holes of the *Vertebrae*.

3. Mam-
maria.

From the *upper* side of each subclavian springs first *Mammaria*, which descends towards the Breasts through the Muscles that fill up the interstices of the cartilages of the true Ribs; and a considerable branch of each descending out of the *Thorax* by the sides of the *Cartilago ensiformis*, run down the *Abdomen* under the *Musculi Recti*, spreading there into many twigs: which are said to insculcate with the extremities of the like twigs of the epigastrick Artery ascending. But that opinion is so opposite to the circulation of the Blood, that it is impossible to be true. For no Blood can ascend by the *Mammariae*, nor descend by these ascending twigs of the *Epigastricae*.

4. Cervi-
calis.

The next is *Cervicalis* (otherwise called *Vertebralis*) which sendeth slips to the *Vertebrae* and Muscles of the Neck, at whose seventh *Vertebra* it enters in by the holes of the transverse processes and pierceth the Membrane that invests the spinal marrow, bestowing twigs both on the Membrane and marrow, and runs up therewith in at the great hole of the *Occiput*, and being enter'd the Skull, both branches (the right and left) join under

under the *medulla oblongata*, and then are divided into innumerable most small twigs which make wonderfull net-like *Plexus* in the *Pia mater* about the *Cerebellum*, and run into the substance of the *Cerebellum* it self; and some of them being united with those of the *Carotides* make part of the very *Rete mirabile*.

The third Artery that rises out of the upper side of the subclavian is *Muscula*, which is spent on the muscles of the Neck, and sometimes also on some of the Arm. 5. Muscu-
la.

After the *Subclavians* have had all these pairs of Arteries going out of them, they pass out of the *Thorax*, and begin to be called *Axillar*, of which in Book 4. Chap. 2.

At the same place, or very near, where the ascending trunk of the *Aorta* sends out the *Subclavians* side-ways, the remainder of it is divided into two, called *Carotides*, which ascend directly upwards, (though the right sometimes arises from the right *Subclavian*.) These at their rise are sustained by the *Thymus*, and having bestowed twigs on the *Larynx*, Tongue, the Muscles of the *Os hyoides* and the neighbouring Glands, pass up on each side by the sides of the Wind-pipe to the Jaws with the internal Jugular vein, and there are each subdivided into the *external* and *internal* branches. Carotides.

The *external* is smaller, and is dispersed into all the Muscles of the Cheeks, Fore-head, Temples, Lips; and in general, through all the outer parts of the Head and Face.

The *internal*, which is larger, sends first some more twigs to the *Larynx*, Tongue, &c. as also to the Glands behind the Ears, and the spongy parts of the Palate and Nose. Then it entereth the

the upper Jaw, and bestows a small slip on the root of each Tooth (as the external did on the roots of the Teeth of the lower Jaw) whereby sharp humours flowing in upon them sometimes cause a very painfull Tooth-ach. The remainder of it climbs upon the Skull, being about its *basis* divided into two branches. The *less* and hinder whereof having sent one slip to the inner Muscles of the Neck, and another through the hole of the uppermost *Vertebra* into the Membrane that invests the spinal marrow, ascending further enters the Skull at the hole by which the sixth pair of Nerves (commonly so called) comes out, and creeping along the *Dura mater* ends near its *Sinus*, (which yet some say it enters.) The *larger* branch, tending upwards is carried through the bony channel in the wedge-like bone with a winding duct to the *Sella equina*; at whose *basis*, after it has sent out a twig on each side into the *Dura mater*, it opens it self into many small slips, which being interwoven with those of the cervical Artery (above-mentioned) make the *Rete mirabile*, which is more observable in Beasts than in Men. Yet it is not all spent on the said slips, but perforating the *Dura mater*, it enters the *Pia mater* with two notable branches, which being divided into very small twigs are mingled with those of the cervical Artery, with which they pass out of the Skull and accompany the spinal marrow even to the Loins. Afterwards it sends a small branch through the second hole of the wedge-like Bone with the optick Nerve, out of the Skull, to the Eye. And yet still supplying more twigs to the substance of the Brain and *Pia mater*, and being united with some other twigs of the cervical Artery, it makes the *Plexus choroides*.

The

The descending trunk of the Aorta, which is larger than the ascending, goes down by the Gullet, to which it cleaveth. And hence is a Man that is hot, so much cooled with a draught of cold drink; for the Gullet being cooled thereby, the Blood in the Aorta contiguous to it must needs be cooled likewise.

Before it arrive at the Diaphragm it sends out of its hinder side the inferior Intercostals, which run along the interstices of eight or nine of the lower Ribs, namely those which the superior Intercostals did not supply. They likewise send sprigs by the holes of the Vertebrae made for the Nerves, to the marrow of the Back, and to the Muscles which rest upon the Vertebrae, and also to those of the Thorax. Sometimes above this and sometimes below it, there arises also out of the hinder part of the Aorta, an Artery called Bronchialis, first found out and so named by Frederick Ruysch, which accompanies all the Bronchia of the Wind-pipe.

When it comes to the Midriff, there spring out of it the Phrenicæ, one on each side: these running all through the Diaphragm, pass up into the Mediastinum, and sometimes into the Pericardium.

Then having penetrated the Midriff it descends in one trunk to the fifth vertebra of the Loins; in which passage it first sendeth forth Cæliaca which ariseth single, and is so called, because it sendeth twigs to the Stomach. This springeth from the fore-part of the Trunk, at the first vertebra of the Loins, and descending under the hollow of the Liver, upon the trunk of the Vena Portæ it is divided into two branches, the right and left.

Its branches.
Gastrica
dextra.
Cystica
gemellæ.

The *right* which is smaller, ascending, produces in its upper part the *Gastrica dextra*, that comes to the *Pylorus*, whence *Spigelius* calls it *Pylorica*. And besides, the *Cystica gemellæ*, which are very small, and are dispersed through the Gall-bladder. And out of its lower side there spring out of it,

Epiplois
dextra.

1. *Epiplois dextra*, which runs through the right side of the inner or hinder leaf of the *Caul* and the *Colon* that it is annexed to.

Intestinalis.

2. *Intestinalis*, bestowed on the *Duodenum* and beginning of *Jejunum*.

Gastroepiplois
dextra.

3. *Gastroepiplois dextra*, on the right side (to the middle) of the bottom of the *Stomach*, and also on the *Caul* that is knit to its bottom.

Hepaticæ.

4. *Hepaticæ*, which are two small ones: these are spent on the investing membrane of the *Liver* (for its *Parenchyma* is nourished by the *Porta*) the *Capsula communis*, the Gall-bladder and *Porus biliaris*.

The remainder of this *right* branch enters the *Mesentery* with many twigs.

Splenica.

The *left* branch of the *Celiacæ*, which is called *Splenicus* (sometimes springing immediately from the *Aorta*) is larger than the right, and as it goeth towards the *Spleen* it sendeth forth of its

Gastrica
major.

upper side *Gastrica major*, which after it hath bestowed a slip on the upper and middle part of the *Stomach*, is divided into two others; the

Coronaria
stomachica.

first whereof is called *Coronaria stomachica*, which encompasses the upper orifice of the *Stomach* like a *Garland*, and sends many twigs to the body

Gastrica
sinistra.

of the *Ventricle* it self; the other *Gastrica sinistra*, which (according to *Diemerbroeck*) is carried towards the right hand into the upper part of the *Stomach* and to the *Pylorus*. Out of its lower side

side spring, first *Epiplais postica*, which runs to the hinder leaf of the *Omentum*, and the *Colon* annexed to it; secondly *Epiplais sinistra*, which is bestowed on the lower and left side of the *Omentum*.

Epiplais postica.

Epiplais sinistra.

Just as this splenick branch is entring into the Spleen, there arise out of its upper part *Vas breve arteriosum*, which goeth streight to the left part of the bottom of the Stomach; and the *Gastroepiplois sinistra*, which being sustained by the upper or fore leaf of the *Omentum* sends some twigs thereto, and also to the left part of the bottom of the Stomach, and to both its fore and hinder sides. Then it enters into the Spleen, whose branchings therein we described in the former Book, Chap. 16. of the Spleen.

Vas breve arteriosum.

Gastroepiplois sinistra.

All these Arteries spring from the *Celiacæ*, and accompany the Veins of the *Porta* of the like denomination.

The next that arises out of the trunk of the *Aorta* is the upper *Mesenterick*, which springs from the fore-part of it as the *Coeliacæ* did. It accompanies the *Vena mesaraica* of the *Porta*, and runs through all the upper part of the Mesentery, and bestows many branches on the Guts *Jejunum*, *Ileum* and that part of *Colon* that lieth in the right Hypochondre.

4. *Mesenterica superior.*

Immediately below this, about the second vertebra of the Loins, there go out of each side of the descending trunk of the *Aorta* an *Emulgent* artery, each of which being after its rise divided into two and sometimes three branches, enters the Kidney of its own side. The right springs out of it a little lower than the left. Both are subdivided into innumerable twigs in the *Parenchyma* of the Kidneys, (all of which are invested with the Veins in one common *capsula* borrowed

5. *Emulgentes.*

from the *Pelvis*) and their Capillaries end in the Glands, wherein the *Serum* that these Arteries bring with the Bloud is separated therefrom, and carried from them by the urinary Siphons into the *Pelvis*, of which more in the former Book, Chap. 17. of the Kidneys.

6. Sper-
maticæ.

Next to these arise the *Spermaticeæ* (called *Arteriae præparantes*.) These go out of the fore-part of the Trunk very near together (very seldom either of them out of the Emulgents, as the left Spermatick vein does) and the right passes over the trunk of the *Vena cava*. About two fingers breadth from their rise they are each joined with the *Vena præparans* of their own side, and descend with them in *Men* through the process of the *Peritonæum* to the Stones, being divided into two branches a little before they arrive at them, one of which runs under the *Epididymus*, and the other to the *Testis*. In *Women*, when they come near the *Testes*, (or *Ovaria*) they are divided also into two branches, one whereof goes to the *Testis*, and the other to the bottom of the Womb.

7. Mesen-
terica in-
ferior.

Next below the Spermaticks springs the *lower Mesenterick* out of the Trunk a little before it is divided into the *Rami iliaci*. This entreth the lower region of the Mesentery, and distributes many branches to the left part of the *Colon* and to the streight Gut, and lastly descending to the *Anus*, makes the internal hemorrhoidal Arterie.

8 Lum-
bares.

Very near to this, out of the Trunk still, arise the *Lumbares*, reckoned four in number. These go out of the backside of the *Aorta*, and are distributed not onely to the neighbouring muscles of the Loins, and to the *Peritonæum*, but enter in at the

the holes of the *vertebrae* of the Loins, and run along the Membrane that involves the spinal marrow, and penetrate into the marrow it self.

Besides these some reckon other two, on each side one, called *Musculæ superiores*, (which run to the Muscles of the *Abdomen*) unless these be two of the four called *Lumbares*.

When the Trunk is descended as low as the fifth or last *vertebra* of the Loins and the top of *Os sacrum*, it begins to climb upon the *Vena cava*, under or behind which it passed thus far. But as it begins to get upon it, it is divided into two equal branches called *Rami iliaci*, and at its very division there springs out of it *Arteria sacra*, whose small twigs entring in at the holes of *Os sacrum* penetrate into the marrow contained in it.

The Trunk of the descending *Aorta* being divided into the *Rami iliaci*, these are subdivided presently into the *interiour* and *exteriour* branches.

From the *interiour*, which is less, proceed three others.

First, the *inferiour Muscula* (called otherwise *Glutæa*) which is bestowed on the Muscles named *Glutæi* that make the Buttocks, and also on the lower end of the *Iliack* muscle and the *Psoas*.

Secondly, the *Hypogastrick*, which is large, and at the lower end of *Os sacrum* runs to the Bladder and its Neck, and the Muscles that cover the *Ossa pubis*. In *Men* it goes also along the two nervous bodies of the *Penis* as far as the *Glans*: and in *Women* it is distributed in numerous branches into the bottom of the Womb and its Neck, out of which for the greatest part issue the *Menses* in their monthly purgation. It goes also to the *Podex*, where it makes the external hemorrhoidal Arterie.

X 3

Thirdly,

3. Umbilicalia.

Thirdly, the *Umbilical* artery, which ascending by the sides of the Bladder, and being inserted into the *Peritonæum*, proceeds betwixt the two membranes thereof to the Navel, out of which it passes in a *Fetus* in the Womb, and runs into the *Placenta uterina*, of which before, *Book I. Ch. 33.* But after the Infant is born, when there is no more use of it, it closes up, and turns into the nature of a Ligament, in some measure sustaining the sides of the Bladder, and hindring it from pressing on its Neck.

From the *exteriour branch* of the *Ramus iliacus* two Arteries arise.

4. Epigastrica.

First, the *Epigastrick*, which turning upwards on the outside of the *Peritonæum* runs betwixt it and the *Musculi recti* of the *Abdomen* as high as the Navel, where the Mammary artery meets it, and according to tradition (though false) inosculates there with it. Of which before, in this Chapter.

5. Pudenda.

Secondly, *Pudenda*, which sends forth a notable Artery on each side into the nervous body of the *Penis* in Men, and into the *Clitoris* in Women, Hence it is carried inwards by the jointing of the *Ossa pubis* to the *Pudenda* and Groins, and their Glands, and is spent on the Skin of those parts, and of the Yard (in Men.)

When all these pairs of Arteries have arisen out of the *Rami iliaci*, they run down out of the *Abdomen* to the Thighs, where they begin to be called *Crurales*, where we shall leave them till we come to speak of the Arteries of the *Limbs*, *Book 4. Chap. 5.*

Having now traced all the Arteries springing out of the *Aorta* (whether out of its *ascending* or *descending* Trunk) in the *Thorax* and *Abdomen*, taking

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Fig. 1



Fig. 2

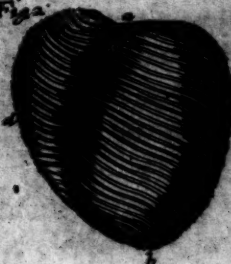


Fig. 3



Fig. 4



Fig. 5



Fig. 6



Fig. 7



taking occasion to doe so, because the great Artery out of which they all arise, has its origine in the Heart, to which we have considered it as an appendage; we shall pass on to the description of the remaining parts in the Breast, not yet spoken to.

Tab. XI.

Representeth the Fibres of the Heart, with its Auricles, Ventricles, Valves, &c. (from Dr. Lower.)

Fig. 1. sheweth the outmost or streight fibres of the Heart.

a The basis of the Heart.

b Its Cone.

c The streight fibres tending upwards towards the basis.

Fig. 2 sheweth the second rank of fibres (which are oblique) lying next under the former, which ascending obliquely from the left side towards the right, terminate in the basis of the Heart, imitating a snail-shell, or screw, by their spiral circuit.

a The basis of the Heart.

b The Cone.

c The fibres that encompass the left Ventricle.

d The fibres encompassing the right.

e A sinus in the interstice of the Ventricles made for receiving the vessels of the Heart.

Fig. 3. sheweth the third or inmost rank of fibres, which are oblique also, but run a contrary course

course to the former; for they arise every where from the right side of the Heart, whence being carried obliquely towards the left, and embracing each ventricle of the Heart they ascend to the basis of the left side.

- a *The basis of the Heart.*
- b *The Cone.*
- c *The right side of the Heart.*
- d *The left.*
- e *The fibres of the right Ventricle.*
- f *The fibres of the left.*

Fig. 4. shews the right Auricle of the Heart inverted and laid open.

- aaa *The basis of the auricle, where it is united to the tendon of the Heart.*
- bbb *The tendinous circle whereby it is distinguished from the Vena cava.*
- ccc *The carnosus fibres which are carried to the diverse or opposite tendons.*
- d *The coronary Vein.*
- ee *Other lesser Veins appointed for bringing back the blood which remains from the nutrition of the Heart.*
- f *the upper part of the Auricle.*

Fig. 5. shews the inner *sinus* of the left Ventricle.

- aaa *The pulmonary Vein laid open before its entrance into the Heart.*
- b *The left auricle of the Heart.*
- c *The Foramen ovale, whereby the blood flows out of the Vena cava into the pulmonary Vein just before the door of the left ventricle.*
- dd *The*

- dd The two Mitral membranes or valves.
- ee The fleshy columns protuberating out of each side of the ventricle.
- g The place under the Mitral membranes where the blood is sent forth into the Aorta.
- h The cone of the Heart.
- iii The carnos Fibres running on every side through the whole circuit of the inside of the ventricle.

Fig. 6. sheweth the semilunar valves at the rise of the Aorta out of the left ventricle, (whereunto those at the rise of the pulmonary Artery out of the right ventricle are like.)

- aa Part of the left ventricle laid open.
- bbb The three semilunar valves conciding loosely that they may yield an exit to the blood bursting forth.
- c The trunk of the Aorta laid open.
- dd The two coronary Arteries rising immediately without the semilunar valves.
- ee The root of the Aorta where it is united with the tendon of the Heart.
- ff The Mitral membranes divided and turned back on each side, that the semilunar valves may come into sight.

Fig. 7. shews the semilunar valves closed.

- aaa The trunk of the Aorta cut off at the root.
- bbb The three semilunar valves coming close to one another, and hindring the recourse of the blood out of the Aorta into the ventricle.
- cc The two coronary Arteries.

C H A P. XII.

Of the Aspera arteria and Lungs.

The Wind-
pipe.

AS in the first Book, being to treat of the Stomach, we first described the Gullet, which serves as a Tunnel to it; so the same reason induces to begin with the Windpipe, called *Trachea* or *aspera Arteria*, thereby to usher in the description of the Lungs, to which it performs the same office as the Gullet to the Stomach, this receiving in Air, as that does Meat and Drink.

Its figure
and sub-
stance.

The *Aspera arteria* then is a long Pipe, consisting of Cartilages and Membranes, which beginning at the Throat or lower part of the Jaws and lying upon the Gullet descends into the Lungs through which it spreads in many branchings.

Parts.
1. La-
rynx.

It is commonly divided into two parts, the upper which is called *Larynx*, and the lower, that is named *Bronchus*. Of the former we shall speak in Chap. 14. where we shall treat of the parts contained in the Neck; of the other here.

2. Bron-
chus.

By the *Bronchus* we mean all the *Trachea* besides the *Larynx*, as well before as after it arrive at the Lungs. It is joined immediately to the *Larynx*, to whose lowest Cartilage all those of the *Bronchus* (so far as it rests upon the Gullet) are assimilated. These Cartilages are like so many Ribs, Hoops or Rings, seated one below another at equal distances, and kept in their places by the inner membrane of the *Trachea*, which fills up their interstices and ties them one to another

Its carti-
lages and
mem-
branes.

ther like a Ligament. Yet these Rings have not their circle intire, but on the back-side of the *Bronchus* next the Gullet, that they might give way to the Meat in swallowing, they pass into a Membrane, which is the same with the inner Membrane that ties them together. So that they are in figure like the letter C. But this interstice in their circle which most Anatomists affirm to be membranous, *Casp. Bartholin* (after his Father) says is rather "carnous, for there are very plain "and remarkable carnous fibres that run from "one side or end of the Cartilage across to the "other, which in expiration (especially violent) "contracting themselves draw the ends of the "Cartilages towards one another on each side, "and thereby straiten the pipe of the *Trachea*.] And though the Cartilages so far as they are contiguous to the Gullet are thus semilunar as it were; yet those of the branches of the *Bronchus* within the Lungs have no interstice in their circumference, being all cartilaginous, though not all of a circular figure, but some four-square, others triangular, &c. as *Diemerbroeck* observes.

Besides the inner there is also an outer Membrane that helps to connect these Cartilages the more firmly one to another, and the whole *Trachea* to the neighbouring parts, that it may more safely and firmly descend into the *Thorax*. This is much thinner than the other: for the inner (according to *Dr. Willis*) has two rows of muscular Fibres, the outer streight, the inner oblique; the first by their contraction shorten the *Trachea*, the latter straiten it: so that he thinks they assist expiration, especially when it is violent, as in coughing, hawking or the like. Yea he says, this inner membrane has two others growing

growing upon it as it were, one glandulous, and another vascular. Through this latter do the blood-vessels and Nerves every where run ; and the glands placed in the former receive and keep all the superfluous moisture or *lymph*a deposited by the Arteries which the Veins do not imbibe, till they can remand it by the Lympheducts (which spring from them ;) or if it be over plentiful, so that the Lympheducts cannot receive it all, then it issues both out of these Glands and out of the Arteries into the Cavity of the Wind-pipe and causes a Catarrh. But the inside of this membrane is naturally moist, being besmear'd with a fattish and mucous humour, to hinder its drying, and to make the voice smoother : so that when this humour is fretted off in Catarrhs, or the inside of this membrane becomes rough from any cause, the voice becomes hoarse ; and when it is dried by too much heat, as in Fevers, it becomes squeaking.

Vessels.

The *aspera Arteria* has *Veins* from the external Jugulars. *Arteries* from the *Carotides*, and from the *Arteria bronchialis*, (first found out by *Frederick Ruysch*) which springs from the backside of the descending trunk of the *Aorta*, a little above the lower Intercostals. *Nerves* it receives from the recurring branches of the *par vagum*, which run mostly along its inner membrane, whence it becomes so exquisitely sensible.

Division.

When it is descended as low as the fourth *vertebra* of the *Thorax*, it is divided into two Trunks, whereof one goes into the right lobe of the Lungs, the other into the left, and each is presently again divided into two, and those into others, till at last they end in very small branches, which are dispersed among the like branches of the pulmonary

monary Artery and Vein, and end into and are continued with the little Bladders that make up the greatest part of the bulk of the Lungs. For

Though the Lungs (called in Greek *πνεύμων*, à *The*
πνέω to *breath*) have been held to be of a car- *Lungs.*
 nous substance, not much unlike the Liver or *Their*
 Spleen; yet *Malpighius* hath discover'd them to *Substance.*
 be of a far other, namely soft, spongy and rare,
 made up of most thin and fine Membranes con-
 tinued with the inner coat of the *Trachea*, which
 Membranes compose an infinite number of little
 round and hollow Bladders, so placed that there
 is an open passage from the *Trachea* out of one
 into another, and all terminate at the outer
 Membrane that incloseth the whole Lungs.

These Bladders though they are continued to
 the *Bronchia*, yet they have no Cartilages as those
 have; but though they are very fine, yet they
 have muscular Fibres, whereby they contract
 themselves in expiration, but not so close as to
 expell all the Air included in them; for if the
 Lungs had wholly subsided and fallen flat and
 close in expiration, they would have given some
 stop to the circulation of the Bloud through them
 out of the pulmonary Artery into the Vein;
 whereas now that there remains still so much
 Air in these *Vesiculæ* as to keep the Lungs a little
 pufft up and rare, the Bloud can pass the more
 easily and swiftly through them.

That there are such Bladders annexed to the
Bronchia, *Diemerbroeck* shews by two notable Sto-
 ries: The one of a Stone-cutter's Man that died
 of an *Asthma*, in whom he found these *Vesiculæ* so
 stufft with the dust of the hewn Stone, that when
 he cut his Lungs open, his Knife seem'd as if it
 went

went through an heap of Sand : The other of one that being employed to pick and cleanse Feathers, died of a long continued *Asthma*, and had these Bladders quite fill'd with the fine Dust or Down of the Feathers. From whence he concludes, That whereas in a natural state the Air in inspiration is received as well into these Bladders as the *Branchia*, seeing they could not now admit any Air, being stufft with the aforesaid matters, the Patients were necessarily Asthmatical, and died so.

Investing
mem-
brane.

We said before that all these *Vesiculæ* were invested with a common Membrane in the *superficies* of the Lungs ; and this Dr. *Willis* will have double : The *outer* tunicle is thin and smooth, which seems to be a fine texture of nervous filaments ; the *inner* rough and thicker, consisting almost wholly of the extremities of the Vessels and *Vesiculæ* ; and through the little pits that are all over made in it by them, its inner *superficies* looks like an Hony-comb. This investing Membrane consisting thus of two Tunicles has many large pores, but such as admit not any thing to pass from within outwards ; for if one fill the Lungs newly taken out of a Sheep or the like (before they are cold) with a pair of Bellows never so full of wind, there will none pass out of the Membrane, not so much as to make the flame of a Candle to wave : but on the other side they do admit even liquors to pass from without inwards ; so when the Breast has been opened to let out matter in an *Empyema*, (which was too thick to be absorbed by the too narrow pores) and bitter cleansing injections have been squirted into the cavity of the *Thorax*, to clear it from the purulent matter stagnating in it, it has been observed that a good
part

part of such injections have been hawk'd and cough'd up. And though some think that whensoever Pus is cough'd up, it is certainly bred in the Lungs themselves; yet I am of opinion that in an *Empyema* when it is thin, these pores may be so large as to imbibe it even out of the cavity of the *Thorax*; otherwise I see not how any labouring of an *Empyema* should ever be cured without tapping: for of the two I think this a far more probable way to discharge the matter by, than that it should be imbib'd by the mouths of the Veins gaping (as is suppos'd) either in the superficies of the *Pleura* or *Diaphragm*. But to proceed.

The Lungs are divided into the right and left Division. part, being parted by the *Mediastinum*, and each part is otherwise called a *Lobe*. And because they are two, that have no communication one with the other (save in one common trunk of the *Trachea*, by which the Air comes into and goes out of them) hence in common speech we say *Lungs* in the plural. Each of these parts or Lobes is subdivided into two, sometimes three others, and those into many lesser Lobules, as may be seen in the following Figure taken from Dr. *Willis*.

The Lungs hang loose in the cavity of the *Tho-Connexi-*
rax, being suspended by the *Aspera arteria* that on.
 runs every where through their substance, and is it self sustained by its connexion to the parts of the Neck. Preternaturally (though pretty often) they cleave by their outer superficies to the *Pleura*, and sometimes with their lower end to the *Diaphragm*.

They have all sorts of *Vessels*, that are com-
 mon to them with other parts; but peculiar to
 themselves they have *Bronchia* or the branches of
 the Wind-pipe, for bringing in and carrying forth
 of Air.

Vessels.
 1. *Trachea*.

Their

2. *Arteries*
and *veins.*

Their *Arteries* and *Veins* are the *Arteria* and *Vena pulmonaris*, that accompany all the divisions of the *Aspera arteria* within their several Lobes. These are said to have many anastomoses one with another for the readier circulation of the blood through the Lungs; however, they are admirably interwoven one with another all through the coats of the *Vesiculæ*. But of these we discoursed so largely before, Chap. 10. that we shall say no more of them here. Besides these, that were all the sanguiferous vessels Anatomists had observed to reach to the Lungs, there has of late been found out an Artery by *Frederick Ruysch* (which he calls *Arteria bronchialis*) that seems to convey Blood for the nourishment of the Lungs and *Bronchia*. But of this likewise before (in this Chapter.)

3. *Lympheducts.*

They have abundance of *Lympheducts* that attend upon the Veins and Arteries. Their small twigs running upon the outer *superficies* of the Lungs, towards their root unite into several greater trunks; which being inserted into the common thoracick duct, discharge thereinto the *Lympha* imbibed by them in the Lungs. They may be made to appear very plain in the outward surface, if in dissecting a Live-dog, one press upon the top of the thoracick duct, so as nothing be poured from thence into the Subclavian vein: for then the *Lympheducts* of the Lungs, seeing they cannot unload themselves into the common duct that is now stoppt and full, will swell very much and be very conspicuous. If these *Lympheducts* at any time be obstructed or broken, Dr. *Willis* thinks there often proceeds from thence a Dropsie of the Breast or Lungs, yea Coughs and Phthysical distempers.

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Fig. I.



Fig. II.

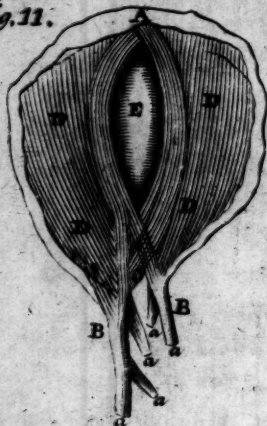


Fig. III.



The last sort of Vessels dispersed in the Lungs are the Nerves. And these proceed from the recurring Nerves of the *Par vagum*, usually called the sixth pair, but Dr. *Willis*'s eighth, who says they are distributed all over the Lungs along with the sanguiferous Vessels and ducts of the *Bronchia*, to supply animal spirits to the muscular Fibres of their Coats.

Their Action is respiration, of which in the next Chapter.

Tab. XII.

Representeth the Lungs, Diaphragm, Ductus salivaris, &c.

Fig. 1. Representeth the Sternum cut off and lifted up, the Mediastinum, Thymus, Lungs, Diaphragm, &c.

AAA The inner superficies of the Sternum and of the Cartilages knit to it.

BB The mammary Veins and Arteries descending under the Sternum.

C The glandulous body called Thymus.

DDDD The sides of the Mediastinum pull'd asunder from the Sternum.

EE The space between the Membranes of the Mediastinum arising from the tearing of it from the Sternum.

GG The Lungs.

HH The Diaphragm.

I The Cartilago ensiformis.

K The external salival duct.

Y

Fig. 2.

Fig. 2. shews the Diaphragm of a Dog (very little differing from that of a man) from Caspar Bartholin.

AAA Shew the courses of the carnous fibres in the upper or fore Muscle, which run streight from the Ribs to the centre or tendinous part of the Diaphragm.

B The centre or tendinous part.

C The hole in the right side of the tendinous part for the transit of the ascending trunk of Vena cava.

DD The lower or hinder Muscle of the Diaphragm.

E The hole in the upper part of the lower Muscle through which the Gullet descends.

F The hole in the hinder part of the lower Muscle through which the Aorta descends.

GGGG Its tendinous extremities whereby it adheres to the Vertebrae of the Loins, formerly called its processes.

Fig. 3. shews the lower or hinder Muscle of a Man's diaphragm, something differing from that of a Dog, (from the same Author.)

A Shews the tendon that intervenes betwixt the upper and lower Muscle, commonly called the nervous centre of the Diaphragm.

BB The lower tendons (commonly called its processes) which arise by five heads as it were (aaaaa) from the vertebrae of the Back and Loins.

C The hole by which the Aorta (lying along the vertebrae of the Back and Loins) descends.

DDDD The fleshy fibres of the lower Muscle in their natural and proper course.

E The hole in its carnous part by which the Gullet descends.

C H A P. XIII.

Of Respiration.

THE *Action* for which the Lungs are appointed by Nature is *Respiration*, which is an alternative *Diastole* and *Systole*, or dilatation and contraction of the Breast, whereby the Air is received in, and driven forth of the Lungs. *The action of the Lungs.*

Now the Lungs do not dilate themselves by any proper power or faculty of their own, being destitute of instruments to perform such an action, (*viz.* Muscles;) nor do they attract the Air by any magnetick property, in inspiration: But the Muscles of the *Thorax* being so framed, that though contraction be the onely and proper action of a Muscle, yet the *Thorax* is dilated by certain of them, as it is contracted by others; whilst it is dilated, there is greater space given for expanding the Lungs, and then the Air partly by the pressure of the Atmosphere, and partly by its proper elastick virtue issues in at the *Trachea*, and insinuates it self into all its *Bronchia*, and through them into the *Vesiculae*, and puffs them all up. The manner whereof is very ingeniously expressed by Dr. Mayow. "Namely seeing the Air through the weight of the superincumbent Atmosphere does not onely rush into all empty places, but also strongly presses upon whatsoever things are next it; it follows that the Air which is continued through the Nostrils and *Trachea* even to the *Bronchia* or entrance of the Lungs, doth bear upon the Lungs from within, and endeavour an entrance into them. Whence it comes

“ to pass that, whilst the insides of the *Thorax*
 “ (which by compressing the Lungs from without
 “ resisted the pressure of that air) are drawn out-
 “ wards by the Muscles of the Breast that are ap-
 “ pointed for its dilatation, and the width of the
 “ *Thorax* is enlarged, that Air which is nearest
 “ adjacent to the *ostia* of the *Bronchia* (all obsta-
 “ cles being now removed) rushes into the cavities
 “ of the Lungs with all the pressure of the At-
 “ mosphere, and puffing them up, occupies and
 “ fills the widened space of the *Thorax*. Nor does
 “ the pressure of the Atmosphere alone, avail
 “ to inspiration; but the Elastick power of the
 “ Air also, whereby it endeavours to extend it self
 “ *in immensum*, is assisting to the same. For the
 “ Air, especially that which is nearest the earth,
 “ is compressed by the weight of the superincum-
 “ bent; whence it always endeavours to free it
 “ self from that pressure, much like as a fleece of
 “ wool, when the force that compress’d it is taken
 “ away, by a certain motion of restitution pre-
 “ sently spreads and enlarges it self. Which may
 “ be confirmed by this known Experiment, *viz.*
 “ If a bladder, out of which the Air is first in a
 “ great measure pressed, be tyed straitly about its
 “ sphincter (or neck) and put into a glass, and then
 “ the Air be drawn out of that glass, the bladder
 “ will presently begin to swell and puff up to its
 “ first dimension. The reason whereof is, that
 “ the Air that was in it, though little, when the
 “ external air (from whose pressure the same was
 “ driven into a narrow space) is removed, pre-
 “ sently expands it self and puffs up the bladder,
 “ yea sometimes bursts it with violence. Just
 “ thus is the inflation of the Lungs caused in in-
 “ spiration: for as soon as the sides of the *Thorax*
 “ (which

"(which by compressing the Lungs make them
 "concide) are drawn outwards, the Air that is
 "at the entrance of the Lungs, whether through
 "the pressure of the Atmosphere, or because of
 "its own Elastick virtue, is presently thrust in-
 "to the Lungs and distends them. But in expi-
 ration the Air is not onely driven forth by the
 compression of the *Thorax*, but also by the con-
 traction of the muscular Fibres of the *Vesiculae*
 and of the inner coat of the *Trachea* and its *Bron-*
chia.

The *Muscles* that assist the dilatation of the
 Breast, are those that lift up the Ribs and draw
 them backwards; which shall be described *Book*
4 Chap. 15. And besides these there is another
 internal Muscle, namely the Midriff, that contri-
 butes towards it, as was shewed *Chap. 3*, of this
Book, where we treated of it. And as for the
 straining or concidence of the *Thorax*, that it is
 not onely a motion of restitution, or a cessation
 of the foresaid *Muscles* from their action, is evi-
 dent, seeing sometimes expiration is performed
 more laboriously and violently than inspiration,
 as in coughing, holloeing, or the like: And there-
 fore Nature has provided peculiar and proper *Mus-*
cles for that purpose, described in the same *Chap-*
ter of the *fourth Book*; and these are assisted partly
 by some *Muscles* of the *Abdomen*, and partly by
 the muscular Fibres of the *Vesiculae* and *Bronchia*,
 as abovesaid.

There hath been great controversie among
 Philosophers whether respiration be an Animal
 or Natural motion. That it is natural, is thought
 to be proved, both in that it is performed as well
 when we are asleep, as awake; and also that
 though it be continued through a Man's whole
 life,

Muscles
mini-
string to
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on.

What kind
of motion
respirati-
on is.

life, yet we are never wearied with it as we are with animal and voluntary motions. On the other side some prove it to be *animal*, first because it is performed by such Instruments as serve for animal motion, namely Muscles; and secondly because at our pleasure we can make it quicker or slower, stronger or weaker, or alter it how we please. Others thinking the arguments on either side convincing, take both in, and suppose it a kind of *mixt* action, partly natural, and partly spontaneous. But I think there is no necessity from the arguments alledged to grant this motion to be *natural*, or any more than *animal* or *spontaneous*. For as to the *first* argument, that the motion is as well performed when we sleep as when we are awake, and therefore it cannot be voluntary; if this were allowed to be of force, we must also grant walking and talking to be natural motions, because many perform them both, when they are asleep. And as to the *second*, from our not being wearied by it, in answer to it we may distinguish of animal actions, into such as are done by instinct and are free, and into such as serve the affections of the mind: the former proceed always and without impediment, even when we think not thereon, but may notwithstanding be directed and moderated when we do think of them, and such is respiration; the latter is not performed continually, as to run, leap, write, &c. In the former there is a plentiful and continual influx of animal spirits into the Muscles, of custome or course, whence there follows no weariness, though they be continual: In the latter, seeing by the determination that is made in the Brain the spirits now flow in and anon cease, sometimes in greater plenty and
some.

sometimes in less, from this mutation and unaccustomedness does the weariness proceed.

Respiration is so necessary to the continuance of life, that after once the *Fœtus* comes into the open Air and begins to breathe, it can hardly live two minutes without it. But upon what account it becomes so necessary is not agreed among learned Men, each party exhibiting such reasons of it, as may best suit with their hypotheses. Hence *some* (and those the most) think that respiration serves for the cooling and ventilating of the Blood that acquires a great heat in the right Ventricle of the Heart, and also for the carrying out fuliginous steams therefrom. *Others*, that it serves for the better mixture of the particles of the Blood as it passes through the Lungs. *Others*, that it condenses the blood; which was very much rarefied in the right ventricle of the Heart, whereby it comes to take up less room in the Lungs and becomes capable of being received into the left Ventricle: yea by the distension of the Lungs, in inspiration the Vessels thereof coming to be compress'd, the blood is thereby squeezed out of the Arteries into the Veins, and so its circulation through the Lungs is promoted, whereas otherwise it would be apt to stagnate and occasion a suffocation. Dr. *Mayow* thinks, that a double benefit, chiefly, accrues by Respiration; *first*, That the blood by the admixture of the Nitro-aereal particles of the Air is fermented, and freed from coagulation; and *secondly*, that the same Nitro-aereal particles being received into the blood are carried to the brain for the refection and supply of the Animal spirits. Lastly, Dr. *Willis*, Dr. *Charleton*, &c. think, that the Air is drawn in for the greater subtilization of the blood, and

The use of it.

accending or continuing the vital flame. Some other opinions there are concerning the primary use of Respiration, which we will not recite, as being less probable: and which of these produced is the most likely, we leave the Reader to judge, being unwilling to enter into the dispute about so difficult a speculation in this short Anatomical Treatise.

Secondary uses of Respiration are, *first*, to form the Voice; and *secondly*, to minister to the sense of smelling by drawing or snuffing up the vapours with some violence through the Nostrils, without which the organ of smelling will scarcely be affected. Which use Dr. Needham draws from Dr. Lower's experiment: who having cut a dogs windpipe asunder in his throat, and turn'd it outward (the wound being in other regards heal'd up again) so that the dog took not his breath by his mouth or nostrils but altogether by his throat; found, that thereby he lost not his voice onely, but his smelling also wholly, so that the most stinking smells would not excite him.

Tab. XIII.

Representeth one Lobe of the Lungs, with its Labules, Membranous interstices, &c. from Dr. Willis.

Fig. 1. sheweth one whole Lobe of the Lungs, in whose superficies the Lympheducts appear creeping this way and that way.

A The orifice of the Trachea cut off, lying in the middle of the vessels.

B The orifice of the subjacent Pneumonick Artery.

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Tab. XIII.

p. 328.

Fig. 1.



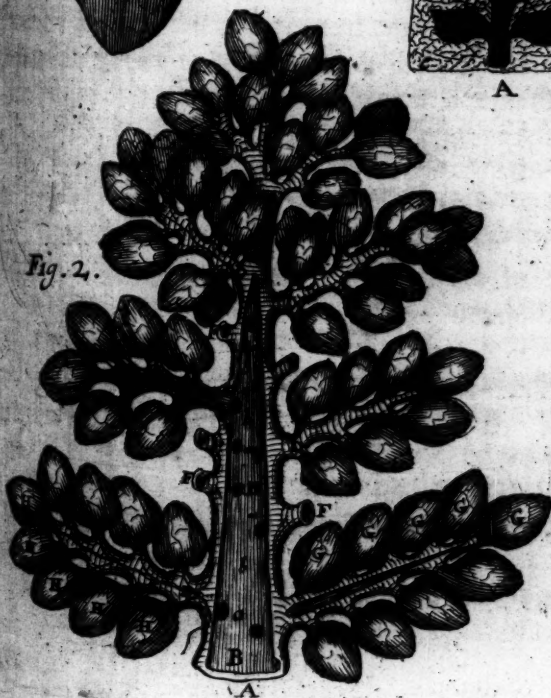
Fig. 4.

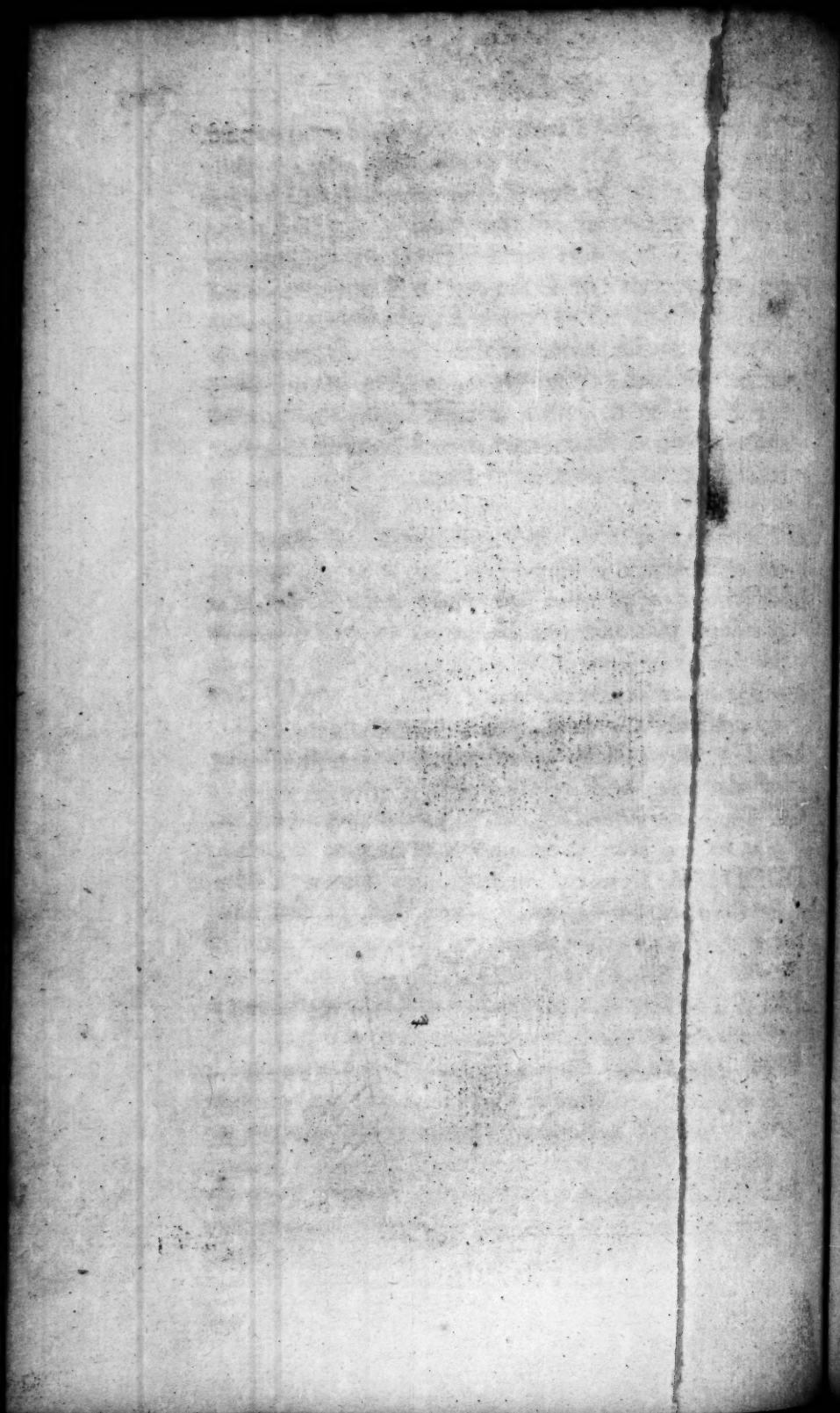


Fig. 3.



Fig. 2.





C The orifice of the Pneumonic vein lying upon the Artery.

ddd &c. The outward Lympheducts dispersed through the surface of this Lobe.

Fig. 2. expresses one Lobe of the Lungs, divided into smaller and very little Lobules according to the ramifications of the aspera Arteria, the branches and off-springs of which vessel being first filled by a liquor injected into them, and then severed from one another as to the Lobules, were drawn by the life.

A The trunk of the aspera Arteria, cut from the rest of its body.

BBB Its wider part cut open, that as well the holes that lead into each branch, as its streight muscular fibres may be seen.

aaa The afore said holes leading into the branches that are extended this way and that way.

bbb The streight muscular fibres whereupon other circular ones lie.

CC The smaller end of this Trunk intire and shut, that the annular Cartilages may appear.

DDDD The Tracheal branches, constituting the lesser Lobules, intire and shut in that place; that the Annular Cartilages may likewise appear in them.

EEEE The like branches cut open, that the holes and streight muscular fibres may be seen.

FFFF The pumps from which the Tracheal branches being cut are removed, that room may be granted to the rest expanding themselves after their division.

GGGG The secondary Lobules hanging upon the stems of the Bronchia like Grapes, which may also

also be subdivided still into lesser Lobules, all whose inner ducts pass out of the bronchia into the vesicular cells.

HHHH The sanguiferous vessels creeping through the superficies of those Lobules.

Fig. 3. expresses a piece of a Pulmonary Lobe, wherein, the membranous interstices being blown up, all the Lobules appear in their proper figure, and somewhat represent a leaf of Polypody.

AA A piece of the Aspera Arteria complicated with the rest of the vessels, upon which, made up of them all, the Lobules grow like the leaves of a Tree.

bbbb The Lobules themselves.

cccc The blood-vessels creeping through them.

dddd The membranous interstices of the Lobules, through which the blood-vessels eeee also creep.

Fig. 4. represents the divarication of a Tracheal branch distributed within one Lobule, and its ramification into the Tubes and orbicular bladders.

AA The stem of the Aspera Arteria.

bbbb The lesser twigs proceeding from that stem.

cccc The transit of these twigs into the orbicular bladders which seem like bunches of Grapes.

dd Sanguiferous vessels distinct from the Pneumonick, which creep upon the Trachea and serve to nourish

C H A P. XIV.

Of the Neck and the parts contained in it, viz.
the Larynx, Pharynx, Tonsilla, &c.

HAVING now dispatched all the parts of the middle Venter or Thorax, we should next proceed to the highest, viz. the Head; but betwixt these two is the Neck situated, like an *Isthmus*, which therefore we must take in our way, and describe the parts contained in it.

It is called *Collum*, either a *Colendo*, because it is used to be adorned with Chains, &c. or because it riseth out of the trunk of the body like an Hill. *Collum* is a general name for the whole Neck; but the hinder part of it is particularly called *Cervix*.

The parts of it are either containing, or contained. The containing are the same which are found in the rest of the Body, saving that the *Membrana carnosæ* seemeth to be more fleshy.

The parts contained are these.
1. The Larynx, which is the upper part of the Wind-pipe, and the instrument of forming the voice.

It is almost round and circular in figure, onely setting out a little before, and something flattish behind, to give way to the Gullet in swallowing.

Its bigness differs according to age, sex, and temperament, whence proceeds the great diversity of voices. Such in whom it is narrow, as in younger people, have shrill and small voices; such as have it wide and are come to maturity, have fuller and more hoarse. The voice is altered

red alſo in reſpect of the length or ſhortneſs of the *Larynx*, and as the Air is more ſtrongly or weakly expelled.

Veſſels.

It has *Arteries* from the *Carotides*, *Veins* from the external *Jugulars*, and *Nerves* from the recurring branches of *par vagum*.

Subſtance.

Besides the Membranes which are common to it with the reſt of the *Trachea* (deſcribed before, Chap. 12.) it is made up of five *Cartilages* and thirteen *Muſcles*.

Cartilages

The firſt *Cartilage* is called *ſuspenſus ſcutiformis*, or *Buckler-like*; for within it is hollow, but without imboſſed or convex: that part which ſticketh out is called *papum Adami*, from an idle ſable; that part of the fatal Apple by God's judgment ſtuck in his Throat, and that this *Cartilage* being thereby diſtended was made to jet out, and the proruherance propagated to poſterity. It is greater in Men than in Women. In its corners it has four proceſſes, two longer ones above, whereby it is joined to the lower ſides of the *os hyoides* by the help of a *Ligament*; and two below, by which it adheres to the cartilage next below it. At the ſides of this cartilage, and the following, are the *Glands* placed called *thyreoideæ*, which Dr. *Wharton* ſays are of the ſhape of a Pear or Fig, being ſomewhat hollow on that ſide next the *Aſpera Arteria*, and ſomewhat copped on their outer ſide. Their ſubſtance is more ſolid than that of other *Glands*, and liket to muſculous fleſh, though it be not fibrous. They contribute to the roundneſs of the Neck by filling up the empty ſpaces about the *Larynx*, and the humour ſeparated in them ſeems to ſerve for the lubricating of the *Larynx*, whereby the voice may be made more ſmooth and ſweet.

The

The *second* Cartilage is called *νεκροειδής annularis*, because it is like a Turkish ring, and compasseth the whole *Larynx*; in the hinder part it is broad and thick.

The *third* and *fourth*, because of the Membrane that invests them, seem but one; but it being removed, they appear to be two. However they have but one name which is *αγυλαειδής guttalis*, because when their two processes are joined together, they are *instar gutturnii* like to that part of the neck of a Jug or Ewer at which we pour out the water. For by their juncture they frame a *rimula* or little chink for the modulating of the voice, called *Glottis*.

The *fifth* is called *Epiglottis*, because it is placed above the *Glottis* or Chink, and covereth it. It is of the form of a Tongue, and is appointed to hinder the falling down of any thing which may prove offensive unto the Windpipe, when we eat or drink. It is pressed down by the weight of the things which are swallowed, for they slip over it down into the *Gula*.

The *Muscles* by which these Cartilages are moved in forming the voice, are thirteen in number; but as for their names and description, the Reader may please to consult Book 5. Chap. 11. *Muscles.*

The second part contained in the Neck is the upper part of the Gullet, which is called *Pharynx*, ^{2. Pha-} *ryn*x. from *φάρυγξ*, because it conveyeth the Meat and Drink towards the Stomach. It is continued to the *Fauces*, (or indeed is the greatest part thereof) reaching up behind to the *Uvula*, on the sides to the *Tonsillæ*, and before to the *Epiglottis*. It is membranous; but not purely so, for it is thick and in some sort carnos. It has seven *Muscles*,

Muscles, to assist it in swallowing, three pair to open it, and an odd one, which is called its Sphincter, to straiten it; of which afterwards
Book 5. Chap. 12.

3. Ton-
sillæ.

The next parts are the *Tonsillæ*, commonly called *Almonds*, which are two Glands seated at the root of the Tongue, on each side of the *Uvula*, and at the top of the *Larynx*, covered with the common Membrane that invests all the Mouth. Dr. *Wharton* says, that though they seem two, yet they are really but one, being continued to one another by a thin and broad production which is of the same glandulous substance with themselves. He says they are of a yellowish colour, and compares their substance to concremented Honey, onely they are of a more firm consistency, but they look sandy like it: They have small vessels from the Jugular *Veins* and *Arteries*, and *Nerves* from the fifth pair.

Their
duct.

They have each a large oval common Duct or *Sinus* that opens into the Mouth, so wide in an Oxe that one may put the top of ones little finger into it. Into this many lesser open, and by it discharge into the Mouth, &c. the liquor that is separated in the Gland. *Fallopious* hath observed this aperture or *sinus* to look like a small ulcer when the Gland has been swelled, and sometimes by unskillfull persons to have been treated as such, when it has onely been forced to gape a little too much through the too plentiful defluxion of humours upon the Gland.

Use.

The use of these Glands is to separate a certain mucous or pituitous matter from the Blood, for the moistening and lubricating of the *Larynx*, Tongue, *Fauces*, and Gullet. Dr. *Wharton* ascribes
a more

a more noble use to them; *viz.* to make a Ferment to further the concoction of the Stomach, yea thinks that they are the chief Instrument of taste.

Besides these there are other Glands in the Neck, ^{4. Glandulæ Jugulares.} which from their situation Dr. *Wharton* calls *Jugulares*; for they are seated by the sides of the Jugular vessels. He says he has observed them to be fourteen on each, besides another longish one separated from the rest, lurking on each side at the root of the *processus styloides* between the Muscles of the Neck and Jugular vessels. They grow in knots as it were, and are of an unequal bigness, varying from the smallness of Coriander seed to the bigness of a Bean. They have no excretory vessel, and so are of the nature of conglobate Glands which return the *Lympha* by the Lympheducts into the blood. Among or near unto these Glands are commonly, those strumous swellings that are so frequent in the Neck.

As for those other Glands which are commonly reckoned as parts contained in the Neck, *viz.* the *Maxillar* and *Parotides*; because their excretory Vessels discharge that liquor that is separated in them into the mouth, we shall defer the description of them to the twenty seventh chapter of the *third Book* which treats of the inner parts of the Mouth. Neither shall we here mention the Veins and Arteries that pass through the Neck to the Head, having described them before in Chap. 9. and 11.

And as to other parts that make up the Neck, *viz.* the seven *Vertebræ*, and eight Muscles, those will come to be treated of in their proper Books: And therefore omitting them here we shall pass on to the Head.

The end of the Second Book.

more noble use to them; and so make a
 ment to further the concoction of the stomach; yet
 thinks that they are the chief instrument of taste.
 Besides these there are other Glands in the Neck, which
 from their situation Dr. Boerhaave calls the Ju-
 gulars, for they are situated by the sides of the Ju-
 gular vessels. He says he has often seen them to be
 found on each, besides another found on
 the root of the vessels, lying on each side as
 the root of the vessels, which is between the Mus-
 cles of the Neck and Jugular vessels. They grow
 in those as it were, and are of an unequal big-
 ness, varying from the smallest of a Glander seed
 to the size of a bean. They have no excretory
 vessel, and so are of the nature of conglomerate
 Glands which again the Glands of the Thyroid
 Glands are commonly, whole numerous Glands
 are to be seen in the Neck.
 As for the other Glands which are commonly
 reckoned as parts contained in the Neck, viz.
 the Adipose and Pustular, being their excretory
 vessels discharge the liquor that is contained in
 them into the mouth, we shall not be mistaken in
 of them as it is a very lowly degree of the skin.
 But which means at the present time we shall
 mention shall we here mention the Venas and Ar-
 teries that pass through the Neck on the Neck
 having described their position in Chap. 9. and 11.
 And as to other parts that are in the Neck,
 viz. the Lymphatic, and the Glands, those
 will come in the next of my proper books.
 And therefore I aming them here we shall pass
 unto the next.

The Third Book.

OF THE
HIGHEST CAVITY,
OR
H E A D.

C H A P. I.

Of the Head in general, and its common containing parts.

NOW followeth the third and highest *The Head.*
Venter of the Body, called Caput, the
Head. This is the most noble Cavity
of the three, containing the Brain, wherein the
rational Soul more especially operates, and where-
by all the animal motions of the whole Body are
moderated and determined ; as well as perfor-
med by means of the spirits elaborated in it, and
sent into all the parts by the Nerves.

It is seated in the highest place of the body, be- *Its seat.*
cause it contains the organs of the Senses, most

of which perform their office more advantageously by this sublime situation. For from hence the Eyes can behold things remote, as from a watch-tower; Here the Ears draw in the sounds that fly aloft; and the Nostrils receive the ascending odours.

Figure.

Its *figure* is spherical; yet somewhat flattish, and longish.

Bigness.

It is *bigger* in Man than in other Creatures, considering the proportion of their Bodies; as his Brain that is contained in it, also is.

Parts.

The *parts* are of three sorts, for they are either 1. distinctive, or 2. expressive of the regions, or 3. constitutive of the whole.

The *parts distinctive* are two, the hairy scalp called *Calva*, and that without hair called *Facies*.

The *parts which express* the regions (of the first,) are four: 1. *Sinciput* or the fore-part, reaching from the Forehead to the coronal suture. 2. *Occiput* the Noddle, or hinder part, beginning at the suture *Lambdoides*, and reaching to the first *vertebra* of the Neck. 3. *Vertex*, the Crown, which is situated on the top of the Head between the bounds of the *Sinciput* and *Occiput*. And 4. the lateral parts descending from this on each side between the Ears and Eyes, called *Tempora* or the Temples.

The *parts constitutive* are either containing, or contained. The *containing* are either common or proper. The *common* are those we treated of in Chap. 3. of the first Book. The *Cuticula* is thinner and softer; but the Skin thicker than in any other part of the Body, yet porous, that room may be left for the hair to grow, and for its nourishment to pass to it. The *Membrana carnosa* in some aboundeth so with Muscular fibres, and cleaveth

cleaveth so close to the Skin, that they can move it at their pleasure.

We shall not need to say more here of these, or of other the *common* containing parts, but refer the Reader to the above-cited place: and now proceed to the *proper*, having first discoursed a little of the *Hair*.

C H A P. II.

Of the Hair.

THE Hairs of the Head are called in Latine *Capilli*, quasi *Capitis pili*, and differ not from the Hairs in any other part of the Body, save in length.

Hair.
Its name.

Now an *Hair* may be defined to be a body cold and dry, small, thread-like, hard and flexible, budding from the Skin.

Definition.
on.

The Hairs are seldom round, but generally four-square, as the stalks of some Plants; sometimes triangular, but always porous, the pores running lengthways. All these things may be observed by the help of a good Microscope. They are sometimes curled, and sometimes hang lank.

Figure.

Hairs are commonly divided into *Congeniti*, such as we bring into the World with us, as those of the Head, Eyelids, and Eyebrows; and *Post-geniti*, such as begin to grow at certain seasons in our life-time, as the Beard, the Hairs growing about the *Pudenda*, on the Breast, in the Armpits, and the like.

Division.

Life.

They are no parts of the Body, and therefore have no *Animal* life; yet they have a *Vegetative* life, and that peculiar to themselves, and not owing to the life of the Body, seeing they continue to grow after a Man is dead, as has been observed in embalmed Bodies. *Dimerbroeck* ingeniously compares them to Polypody or some other Plant growing upon an old Tree, which continue to grow after the Tree is dead as they did before, because they have a proper life distinct from the form or *anima* of the Tree out of which and in which they grow.

Matter.

The matter out of which they are bred and nourished is commonly reputed to be a moist, fuliginous, crass, earthy and somewhat viscid excrement of the third concoction. *Spigelius* thinks they are nourished by Blood: which opinion he grounds on an analogy he supposes there is between Hair, and the Feathers of Fowl; and these latter he says are apparently nourished by Blood, for if one pull one from off a young Fowl, its end is bloody. *Diemerbroeck* dissents not much herefrom, but thinks the Blood to be prepared and concocted in a specifical manner into a crass, earthy and viscid juice. Whatever the matter be, it is attracted by the white roots of the Hairs, and is carried even to their very ends by the pores; just as Plants receive nourishment out of the Earth by their Roots, and communicate it to their outmost parts.

Colour.

The colour of them differs according to the Climate, or to the natural constitution of the party, or to the diversity of those humours that are mixed with the juice whereby they are nourished. In those of cold flegmatick constitutions they use to be of a light colour, in cholerick, reddish, &c.

They

They are most commonly streight in those which are born in cold Countries, but curled in those who inhabit hot Climates.

And as the reason of the difference of the colour of the Hair in several persons is from different temperaments, &c. so the reason why Men in old age grow grey, whenas their Hair before was of another colour, seemeth to be the predominance of flegm in that juice that nourisheth them: whence also the Hairs of the Head and Face soonest turn white, because the Brain does more abound with pituitous humours than any other part of the Body. But it is not so easie to give a reason of some Mens turning grey in one nights time, when they have been under great fears; (of which there are many instances credibly reported.) Yet *Diemerbroeck* gives a reason somewhat probable, *viz.* "That in great fear and terror, the heart by accident is in great anguish, whence it beats little and very weakly, so that some from this cause fall into a swoon: by reason of the weak pulse little blood is impelled into the outer parts, whence by and by they grow cold and stiff: blood failing in the Skin, the colour also in the juice that nourisheth the hair, is by and by changed from that which before was induc'd upon it from the humours mingled with the blood: Then if by chance whitish pituitous humours stuck before in the Skin, they will presently infect the juice that nourisheth the hair with the prevalency of their own colour, which juice passing through the hair continually even to their end and nourishing them, their colour may from hence be changed in a short time, and become white, seeing their substance is diaphanous as it were,

*Why hair
turns
white.*

" easily admitting of any colour which is communicated to it with the nourishment.] See his
 " *Anat. corp. hum.* p. 559, 560. where he answers some objections that may be made against this opinion.

Their use.

The Hairs have three *uses*: for they serve 1. for defence, 2. for beauty, and 3. shew the temperature of the whole Body and Skin.

C H A P. III.

Of the proper containing parts.

THE proper containing parts are six; to wit, the Muscles, the *Pericranium*, the *Periosteum*, the *Cranium*, and the two *Meninges*. Look for the *Muscles* in the fifth Book, and for the *Cranium* in the sixth. Of the other here. And First

The Pericranium.

The *Pericranium* (which is so called from its being extended *περί τὸ κρανίον* about the Skull) is a membrane somewhat thin, dense and white, of exquisite sense, immediately seated under the *Membrana carnea*. It covereth the whole Skull, immediately next to the *Periosteum*, except where the temporal Muscles lie upon the *Cranium*, for it is stretched over them; and seeing it is very sensible and tender, it causeth horrible pain and inflammation, when the temporal Muscle is wounded.

Its connexion.

It is knit to the *Dura mater* by some nervous Fibres, with pass from it to within the Skull by its Sutures, to stay firmly the *Dura mater*, and also the Brain which it invests, from violent concussion. For though in Infants new born these be strongly united and in a manner continued, in-
 much

much that the *Pericranium* is said by some to spring from the *Dura mater* ; yet in process of time they part so, as to be knit to one another onely by these nervous fibres, by which yet, inflammations may be communicated from the *Pericranium* to the Brain.

Next under the *Pericranium* is spread the *Periofteum*, which immediately cleaveth to the Skull and gives it that sense which it hath. It self is a very thin and nervous Membrane, and of very acute sense. All the Bones of the whole Body (except the Teeth) are invested with such alike Membrane, and owe their sense to it. Some deny it to be found here, affirming that the *Pericranium* supplieth its place : But that cannot be so, for the *Pericranium* (as was noted above) goeth above the temporal Muscles, whereas the *Periofteum* always cleaveth close and immediately to the Bone, as here it doth to the Skull under the said Muscles.

These two Membranes outwardly investing the *Cranium* have *Arteries* from a branch of the external *Carotides*, and *Veins* from the external *Jugulars*.

The *Meninges* follow, called by the *Arabians*, *Matres* ; as if all the Membranes of the Body were propagated from them. These are immediately within the Skull as the other were without ; but adhere not close thereto, as those do. They are two in number : the *Crassa meninx* or *Dura mater*, and the *Tenuis meninx* or *Pia mater*.

The *Dura mater* is the outer, that is, is next to the Skull, through whose Sutures sending fibres to (or receiving them from) the *Pericranium*, it is suspended thereby ; for in other places it is

loose from the *Cranium*, saving in its *basis*, to which it is so firmly knit, that it can hardly be pulled from it; or where it is suspended by Vessels entring into it from the perforations of the Skull; or lastly where it adheres to the *os cribroforme* at the top of the Nose, and sends jags through its holes. It is thicker and harder than the inner, whence it has the epithet of *dura*, hard. It consists of a double Membrane, the outer of which is more rough, towards the *Cranium*; and the inner on its superficies next the *pia mater* is more smooth and slippery, being bedewed with a kind of water. This inside is loose, saving that near the *sinus*'s it is knit to the *pia mater* by the insertions of the Veins, and in the *basis* of the Skull by the Arteries and Nerves.

Its holes.

It has many *foramina* or holes for the transit of the Vessels; and besides, one very large one in its *basis* for the descent of the spinal marrow, and another small one which forms the upper orifice of the *Infundibulum*.

Vessels.

It has *Arteries* from the larger branches of the internal *Carotides*, (entring into it through the holes of the wedge-like Bone) and *Veins* from the internal Jugulars. Dr. *Willis* observes, that its *outer superficies* has no where so many twigs of Veins as of Arteries; but that out of its four *sinus* (which are the venous receptacles of the blood) more Veins go forth through its *inner superficies*, which being presently inserted into the *pia mater* are dispersed all over it, and every where meeting the Arteries ascending from the *basis* of the Head, and being branched with them, make manifold *plexus* of Vessels.

Falx.

At the Crown of the Head it is doubled; and its duplicature descending inwards, divides the
Brain

Brain into the right and left side : yet its descent is not quite to the *basis* of the Brain, but onely through the cortical part ; for toward the *basis* both sides of the Brain are contiguous to one another , making one continued body , namely that part of it which is called *Corpus callosum*, of which in the next chapter. This duplicature, because it is broader backwards, and grows narrower forwards, and so resembles in some manner a Reaper's Sickle, is called *Falx*. Now this *Falx* reaches as far forwards as to the top of the Nose, where it is knit to the upper process of the *os cribriforme* that stands up betwixt the *Processus mammillares* , and is called *Galli crista* or Cock's comb. But its hinder and broader part towards the *Occiput* being severed, descends towards both the right and left side, and parts the *Cerebellum* from the *Cerebrum*.

In the said duplicature are formed four *Sinus* Sinus. or Cavities, three pretty large, and one little one. The first, which is the highest and longest, runs along the upper part of the *Falx*, from the top of the Nose lengthways of the Head towards the *Occiput*, where it is divided into two lateral *Sinus* which descend by the sides of the Lambdoidal suture to the *basis* of the *Occiput*. And at the said division the fourth short *Sinus* proceeds inwards from it betwixt the Brain and Cerebel to the *Glandula pinealis*. This place, where all the *Sinus* are continuous to one another, is called *Torcular*, the Wine-press.

Into these Cavities the Mouths both of Arteries and Veins are said to open ; by the former whereof Bloud is extravasated into them, and absorbed again out of them by the latter. Whence if one open the Skull of a live-Creature, Their uses.
one

one may observe a beating in the long uppermost *Sinus*, from the Bloud discharged into it by the Arteries. Dr. *Higmore* thinks, that much Bloud being sent to the Brain by the *Carotides*, all of which is not fit to have Animal spirits elaborated out of it; that part of it which is less fit and necessary for this purpose, is discharged into these *Sinus* to be returned by the Veins; even as a notable branch of the *Cœliack Artery* (when it is come just to the Spleen) is implanted into the *Ramus splenicus* of *Vena portæ*, by which that Arterial bloud that is unmeet or unnecessary for the making of that juice (whatsoever it be) which is excocted in the Spleen, may be remanded back again. And some are of opinion that the Veins also convey some Bloud into these *Sinus*, which being superfluous to the nourishment of the Brain and *Meninges* is poured in hither by the Veins from the respective parts, and is imbibed again by other Veins whose mouths gape into them, (namely the branches of the internal Jugulars) to be returned to the Heart.

Pia mater.

The second (and inner) Membrane investing the Brain is called *Tenuis meninx* or *Pia mater*. This is of most exquisite sense, and endowed with very many Arteries and Veins. It immediately cloaths the Brain and hinders it from running about, and also involves all its windings and circuits, and tying their summities together makes all the superficies of the Brain plain as it were: which upper connexion being loosed, the windings of the Brain, being all invested apart with this Membrane, may easily be separated and laid open. But it is onely the Cortical part of the Brain which this membrane cloaths thus; for the inner surface of the expanded Brain (which

(which is called *Corpus callosum*) is not invested by it; but instead of it (*Dr. Willis* says) "many *plexus* of vessels, commonly called *Choroïdes*, are suspended within its complicature, and fluctuate as it were freely. But within all the other recesses of the Brain, and besides, within the *Plicæ* or *Lamellæ* of the Cerebel, yea within the interstices of each of them and of the *Medulla oblongata*, does this Membrane insinuate it self.]

This Membrane is interwoven with many admirable *Plexus* of Bloud-vessels, both Arteries and Veins. The Arteries are four, viz. two *Carotides* and two *Vertebrals*. The *Vertebral* Arteries being united at the *basis* of the Skull, and making a single trunk, it meets and joins with the *hinder branches* of the *Carotides*; and from the place of their coalition a very remarkable branch ascends on either side under the *limbus* of the Brain, which being carried above the *crura* of the *medulla oblongata* is divided into very many slender and as it were capillary twigs, some of which ascend to the glands seated behind the Cerebel, and the rest make the Arterial part of the *plexus Choroïdes*. The *fore branches* of the *Carotides* do also unite one with the other; and both before and after their joining send forth twigs all over this membrane, but chiefly in the fore-part of the brain. Its *Veins* arise from the four *sinus* of the *dura mater*, (as was observed above from *Dr. Willis*) and these meeting with one another are diversly interwoven one with another and with the Arteries, and return the superfluous bloud by the *Jugular Veins* to the Heart.

Its vessels, and their plexus.

Note, that both the spinal marrow (extended to the bottom of *Os sacrum*) and all the Nerves that

that arise out of it, and out of the Brain, have a double Coat from these two *Meninges*, with which being clothed they run to their designed parts.

CH A P. IV.

Of the Brain in general.

The Brain. **T**HE *Pia mater* being taken away, the *Brain* occurs next; by which here we mean in the general, all that soft or medullar substance which is contained within the whole Skull, and which the Greeks comprehend under the word *ἐγκεφαλον*. It is the general organ of sense, in which the Soul, the governour of the Body, perceives and judgeth of the sensations of all sentient parts; and out of which, as out of a fountain, it communiceth the Animal spirits (bred in the Brain) by the ducts or rivulets of the Nerves to all the sentient parts of the Body, and thereby endows them with the faculty of performing Animal actions.

Its substance.

Its *substance* is moist, viscous, soft, and white. It is not a Glandule, as *Hippocrates* taught, seeing it is the Work-house and Seat of the Animal spirits; whereas Glandules are generally appointed to receive and separate excrementitious humours. Neither is it of a true marrowy substance, as *Plato*, from its softness, friability, and being encompass'd with bones, reckoned it to be; for marrow swimmeth in water, whereas this sinketh. Besides, marrow nourisheth the Bones; but the Brain

Brain nourisheth no part. And lastly, Marrow being cast into the fire melteth and flameth ; but will not the Brain, for the fire makes it more solid. The truth is, if by *Brain* we understand the whole *Encephalos*, it is not of one substance, but divers : for the several parts of it are of a different substance. Thus the outside of the Brain properly so called is of a more ashy colour, and of a more soft and mucous substance, and seems to be permeable by the sanguineous particles : but the inside or *piñ* (as it is called) is more solid (therefore named *corpus collosum*) and consists of small and flattish round fibres, as *Malpighius* has observed by the Microscope. These fibres, he says, are not unlike those white bodies, or *intestimula*, which the testicles are made up of ; and in the Ventricks of the Brains of Fish they are so apparent, that if you hold them betwixt you and the light, they represent the small teeth of an Ivory comb. He saith, they are inserted by their ends into the *Cortex* or the ash-coloured outer part of the Brain, (just like the numerous jaggy roots of plants into the earth) and seem all of them to have their egress out of the trunk of the spinal marrow within the Skull. As for the other parts of the *Encephalos*, viz. the Cerebel and *Medulla oblongata*, their substance shall be treated of afterwards, when we come to their description.

The Brain for its nutrition and for confection of Animal Spirits receives Bloud by *Arteries* derived from the *Carotides* and *Cervical*, whose Capillaries are dispersed through its substance : and what is superfluous to the said uses is partly resumed by the *Veins* of the *Meninges*, and partly deposited in the *Sinus's* of the *dura mater* by the Arte-
Vessels.

Arteries themselves, out of which it is resorbed by the internal branches of the Jugulars, and thereby conveyed back to the Heart. The Arteries inosculate one with another (*i. e.* the right *Carotides* with the left) and so do the Veins also; but not the Arteries with the Veins. It is from the Pulse of the Arteries altogether, that the beating (or *Systole* and *Diastole* as it were) of the Brain proceedeth.

Bigness.

A Man of all other living Creatures hath the biggest Brain; for it weigheth four or five pound in some; and is as big again as an Oxe's Brain.

Figure.

The outer surface is full of windings, like those of the Guts, which are severally invested with the *Pia mater*, as also tied together by it. The whole Brain is much of the same shape with the Head, *viz.* roundish; but with bunchings out towards the Forehead.

Of its Action we shall speak in the ninth Chapter.

C H A P. V.

Of the manner of dissecting the Brain: of the Brain properly so called, the Fornix, Septum, and the three Ventricles.

There are several methods of dissecting the Brain; some beginning at the Crown, which was the old way; some on the right side, as *Sylvius*; and some behind, as Dr. *Willis*: whose Anatomy of the Brain being much more accurate than that of any before him, we will endeavour

endeavour to give a short but faithfull abstract of it.

Having taken out of the Skull the whole *Encephalos*, or all that which is contained under the name *Brain* taken in a large sense, first of all let the hinder *limbus* or bordure of the Brain properly so called, where it is knit to the *Cerebellum* and *Medulla oblongata*, be freed as clear as may be from its cohesion with the subjacent parts, cutting asunder the vessels and the membranes on every hand, for by these onely is it joined to them. Its hinder part being thus loosened, lift it up and turn it forwards, whereby the *Crura* of the *Medulla oblongata* will lie bare, and the three *Ventricles* of the Brain, commonly so called, will become one empty space, as being a vacuity merely resulting from the complication of the Brain. Moreover one may then see, how the two tips of the *Crura* of the *Medulla oblongata* are knit in two places to the *Corpus callosum* or medullar part of the Brain; as also observe the *Fornix* so called, how it is like a *subtensa*, or line drawn under the arch of a circle, which beginning before, where the aforesaid tips of the *Crura* adhere to the Brain, runs to the Brains hinder bordure, to which it is united by two stretched out arms as it were, and so keeps the whole *compages* of the Brain in a spherical figure, hindring it from spreading into a plane, and ties it firmly to the *Crura* of the *Medulla oblongata*.

The manner of dissecting the Brain.

This is Dr. Willis's manner of dissection, where-in the parts occur to the Dissectors inspection in this order.

First the Brain it self, whose outer surface is all full of windings, like the convolutions of the *Guts*: It is divided by the *Falx* (above-described)

The Brain properly so called.

bed) into two hemispheres, a right and left ; and these are subdivided each into two Lobes, a fore and an hinder, by a large branch of the Carotid Artery running cross the middle of them. How deep the *Falx* enters into the Brain, and of what substance the Brain is, has been shewn in the former chapters : We shall onely further note here concerning its substance, that its medullar part (or *Corpus callosum*) is both thicker and closer by much in the fore parts of each hemisphere than any where else ; and that where it is thickest, it adheres on each side to the tips of the *Crura* of the *Medulla oblongata* (called *corpora striata* :) but from these tips, as from its rise, being expanded towards the hinder parts, it grows thinner by degrees, and towards its outer bordure its under side is knit to the *Candex* or trunk of the *Medulla oblongata* by membranes and vessels.

Fornix.

Which membranes and vessels being cut in sunder, and the Brain turned up forwards as above-directed, on its inner or under *superficies* there appears a medullar process called *fornix*, which springing forth of the *corpus callosum* with a double root, is united into one broad process near the place where the tips of the *crura* of the *medulla oblongata* adhere to the under-side or medullar part of the Brain, and serves as a *subtensa* to its arch. Under the double root of the *Fornix* there lies a medullar trunk, like a large Nerve, running cross the brain and joyning one *corpus striatum* to the other. And out of the middle superficies of the *fornix* there stands up a thin and pellucid *septum* or partition, which is fasten'd to the roof or arch of the *corpus callosum* almost through its whole duct. And thus while the

Septum.

the three-sided *fornix* doth subtend the arch that arises from the complication of the Brain, it divides its cavity as it were into *three partitions*, and makes them look like so many *Ventricles*, by which name they have been described by former Anatomists.

To these three *Ventricles* thus accidentally formed, the Ancients have attributed a noble use: determining them to be the Work-house of the Animal spirits, where they are both generated, and perform the chief works of the Animal function. They distinguished them into *two anterior*, and *one posterior*. But the truth is, there is but one cavity or *vacuum*, and instead of that noble use heretofore ascribed to it, late Anatomists make it onely as a sink or common-shore for excrementitious matter to be collected in, and to be discharged out of again by convenient ways. This excrementitious matter is generally a serous humour which is separated from the Blood in the adjacent *plexus choroides* by the help of those many glands that that *plexus* is beset withall, and of the *glandula pinealis* which the *plexus* hangs upon and is woven about like a button. As to the exit of this serous humour, formerly it has been supposed to flow from hence to the *processus mammillares*, and from them to destill through the *os cribriforme* into the Nose. But Dr. Lower denies any such office of the *os cribriforme*, affirming that the holes in it are onely for the transit of the Nerves and Membranes going forth from the *processus*, and that these fill them so close that nothing can flow through them. And says, that the flux of Rheum through the Nose, and upon the *Uvula*, or into the mouth, &c. in Catarrhs, falls not from the Head, but is separated from the

A a

Arteries

Arteries in the Glands of the respective parts, as into the Nose through the Glands of its investing membrane, &c. And as to the serous matter that is infused into these *sinus* in the Brain, he says it is all absorbed again by the vessels gaping into them and returns by the Jugular veins to the Heart.

C H A P. VI.

Of the Medulla oblongata and its fore parts, viz. Crura, Corpora striata, Nervorum opticorum thalami, Nates and Testes; as also of the Glandula pinealis, Plexus chorooides, and Infundibulum.

THE Brain continuing turned up forwards as above-directed, the *Medulla oblongata* lies open to view, whose parts, &c. we shall describe in this chapter.

The rise of the medulla oblongata. The *Medulla oblongata* seems to arise from the *corpus callosum* by two heads resembling the letter Y, and the united trunk by and by descends out of the Skull down the spine, wherein it is called the *spinal marrow*, of which afterwards, and onely of its head here.

Its substance. Its *substance* is not like that of the Brain, consisting of an outward or cortical part of an ashy colour, and of an inner medullar and white; but its whole *compages* is medullar: yet it is not pure and shining, but dusky from its many fibres that hold a various course; for in some parts they are striated or rarious as it were; in others direct, running

Clap. VI. Of the Medulla oblongata, &c. 355

running lengthways, and in others circular.

Its two heads or beginnings are called its *crura*, Crura and corpora striata. and the tips or extremities of these *crura* are called *prominentiae lentiformes*, or otherwise *corpora striata*, from the course that their fibres keep. Their ends are blunt, and by a pretty large space of their surface adhere to the medullar substance of the brain where it is thickest. If one cut them in sunder lengthways, then may he observe their *striae*, which have a double tendency; for some descend from their tip towards the *medulla oblongata*, and others seem to ascend from their lower part towards the medullar part of the Brain, the one meeting the other. So that by the help of these fibres there seems to be a free passage for the Animal spirits from the Brain to the *medulla oblongata*, or back again, as there is occasion. We observed above in the former chapter, how there is a medullar process that running across joins one *corpus striatum* to the other, and shall onely note here further, that just behind the lower end of these bodies the *processus mammillares* or smelling Nerves have their rise from the *medulla oblongata*.

When these nerves are arisen out of it, its *crura* Thalami rise into uneven protuberances, out of which nervorum spring the Optick Nerves, and therefore these optico- protuberances are called *Nervorum opticorum thalami* rum.: (what course both the olfactory and Optick Nerves hold towards the Nose and Eyes, shall be shewn in chapter 10.)

Behind these *thalami* the two *crura* of the *medulla oblongata* unite into one trunk, upon whose upper side there grow four more notable protuberances, covering its surface for about the space of an inch, which yet they do not touch in the

middle, having a cavity under them. There grow two on each side, the two formore of which are called *Nates*, and the two hinder *Testes*. The *Nates* (or buttocks) are the larger of the two, and the *Testes* seem onely to be an *epiphyfis* or accretion to these. They are all four like so many round hillocks, and are joyned one to another by certain processes. Under them, or rather betwixt their junctures and the trunk of the *medulla oblongata* that lies there-under, there is left a narrow but long cavity, which is called the *fourth ventricle* by some Anatomists, but by other later that cavity is placed under the Cerebel, as shall be shewn in the next chapter, and the hinder end of this opens into it. There is also a passage from this trait duct down into the *infundibulum*. As to the uses of the *Nates* and *Testes*, the learned Reader may do well to consult Dr *Willis* largely discoursing thereof in *Cerebr. Anat.* p. 93, &c. but I shall not enter upon that dispute as being too conjectural and doubtfull.

Glandula
pinealis.

Betwixt the *Nates* and the *thalami Nervorum opticomum* in a valley as it were, is seated the *glandula pinealis*. It is fasten'd to the subjacent part, sometimes by many slender fibres, and sometimes by two notable medullar roots. Its *basis* is downwards, and its *apex* or end looks upwards. Its substance is harder than that of the brain, and of a pale colour. It is included in a membrane, (which is a portion of the *pia mater*) as in a bag or case: which membrane being full of Arteries and Veins, some of these enter into the gland it self. This Gland *Des Cartes* thinks to be the primary seat of the Soul, and that all Animal operations draw their origine from it: But that seems to be too noble an use for it; and

and it is more likely that it is, onely of the nature of other Glands which are seated near the con-
course of sanguiferous vessels, namely that it may
receive into it serous humours deposited from the
Arterial blood, and retain them till either the veins
becoming more empty resorb them, or Lymphed-
ucts where there are any convey them away.

That this is the true use of the *Glandula pinealis* is the more probable, from that notable *plexus* of
blood-vessels that encompasses it, and hangs upon
it as it were, called *plexus Choroides*, which is
constituted after this manner. From each side of
the *medulla oblongata*, where the *limbus* of the Brain
is knit to it, there ascend in a streight course two
Arteries arising from the hinder branches of
the *Carotides* where they are joyned to the Verte-
bral, which being by and by divided into very
many small twigs, and being met by as many
twigs of Veins coming from the fourth ventricle
of the *Dura mater* (which descends upon the *glan-
dula pinealis*) form this *plexus*, wherein both sorts
of vessels are very much interwoven one with an-
other, and which spreads it self on each hand,
(as by two expanded wings) upon the *crura* of
the *medulla oblongata* as far as to the *corpora striata*:
yet these vessels run almost onely upon the sur-
face of the *medulla*, making no deep insertions ei-
ther into it or into the *corpus callosum* under
which they are also spread. This *plexus* is beset
with very many small glands, and according to
Dr. *Willis* has a double use: first, he says, that
the more watry part of the blood designed for
the Brain is sent into the vessels of this *plexus*, that
the remainder may be more sincere and defecate
for the making of Animal spirits: which watry
part if it be so plentiful that it cannot be all re-
ceived

ceived into the Veins to be returned to the heart, it is then received into the smaller glands where with the *plexus* is beset, but especially by the *glandula pinealis* just now described, by which it is either retained, or if it abound, may destill from them into the subjacent cavity, as into a sink. A second office is to preserve within the plicature of the brain (or in the *corpus callosum*) an heat, which is raised from the blood (as from a fire) that effuates in the complications of the vessels of the *plexus*, and which causes the Animal spirits to circulate in the *corpus callosum*.

Infundibulum.

Thus far as to the parts which appear on the upper side of the *medulla oblongata*, betwixt the *corpora striata* and cerebel. But within this space in the *basis* of the same *medulla* there are other things observable, especially the situation and structure of the *Infundibulum*. Now this *infundibulum* is a tube-like receptacle, outwardly covered with a thin membrane arising from the *pia mater*, and within fenced with a medullar substance, which descends behind the coalition of the two Optick Nerves, betwixt the *crura* of the *medulla oblongata*: Its upper orifice is between the *crura*, and from thence a short tube or pipe descends upon the *glandula pituitaria*, (to be described in the next chapter) upon which serous humours flow down from the upper cavities of the Brain this way, whence it has its name of *Infundibulum* or Tunnel.

And thus we have done with the fore part of the *Medulla oblongata*, which onely lies bare by the turning up of the Brain properly so called: In the next chapter we shall examine its hinder part, which comes to our view by raising up the Cerebel; but of the Cerebel it self first.

C H A P.

C H A P. VII.

*Of the Cerebellum, and the fourth Ventricle;
as also of the hinder part of the Medulla
oblongata, of the Rete mirabile and Glandula
pituitaria.*

BEfore we can take a view of the *hinder* part of the *Medulla oblongata*, it is necessary to remove the *Cerebellum* that is placed upon it, (as the Brain is upon the *fore* part) which therefore we shall first of all describe.

The *Cerebellum* is seated in the hinder part of the Head, being of somewhat a globous figure as well as the Brain it self, and uneven in its surface (like it) by reason of certain convolutions, both the ridges and furrows whereof the *pia mater* is spread over, tying their summities together, covering their deep furrows, and reaching *plexus* of vessels to them all. But its convolutions are not so various and uncertain as those of the Brain, but are disposed in a certain order like so many circles; the *lamellæ* or plates going about its whole compass in a parallel course. All these *lamellæ* have (like the Brain) a cortical part, and a medullar, which seems to be the same as the *corpus callosum* of the Brain.

The Cerebellum, its figure and substance,

Both regions of the *Cerebellum*, viz, the *fore* and *hinder*, terminate in a worm-like process, towards which the *lamellæ* or circles are shortest, lengthning by degrees towards the middle or top.

Its Processus vermiciformes.

The *Cerebellum* has a great many *plexus* of vessels beset with glands, like the *plexus choroides* of the

Vessels and glands.

Brain, which come into sight by separating the *pia mater* from its hinder part : for there the *plexus* creep up on each side by the Worm-like process, consisting on each side of a branch from the vertebral artery and of venous ducts sent out of each lateral *fores* of the *dura mater*. To these *plexus* and *glands* Dr. *Willis* ascribes the same use as to those of the Brain, *viz.* that the glands serve to separate the superfluous phlegm from the arterial blood and to retain it ; and that both the Arteries and Veins not onely running on the surface of the Cerebel but sending twigs into its inner substance, the most subtile and spirituous part of the blood being conveyed through long windings and serpentine ducts of vessels, and so sublimed into spirit, is received and retained within, whilst the more impure and seculent part is sent back by the twigs of Veins that are also deeply inserted into the Cerebel.

Pedunculi.

It rests upon the trunk of the *medulla oblongata*, or rather seems to stand upon each side of it by two feet or stalks, betwixt which feet on the sides, the *cerebellum* above, and the *medulla oblongata* underneath, there is formed a cavity which is commonly called the *fourth Ventricle*, of which by and by.

Their processes.

In each of these feet that sustain the Cerebel, there are three distinct medullar processes ; The first of which proceeding from the *Nates* ascends obliquely ; the *second* descending streight from the Cerebel, and passing across the former, encompasses the *medulla oblongata* ; and the *third* descending from the hinder region of the Cerebel, is inserted into the *medulla oblongata*, encreasing the thickness of its trunk.

The annular protuberance.

The second of these processes, *viz.* that which descends

descends straight, is it which makes the *annular protuberance* upon the *medulla oblongata*, which it forms in this manner. Descending straight upon the *medulla*, as soon as it touches its sides, it seems not to be presently implanted into them, but growing into a greater bulk encompasses the surface of the said *medulla* with divers circular fibres. So that the fibres of the process of one side meeting those of the process of the other side underneath or at the *basis* of the *medulla*, make this circular protuberance. Which that it may be seen, as also the three processes of each foot of the *Cerebellum*, &c. 'tis necessary to cut the Cerebel through the middle: from one Worm-like process to the other, for then they will all appear plainly.

The office of the Cerebel has generally been reputed to be the same with that of the Brain, *viz.* ^{The office of the Cerebel.} to elaborate the Animal spirits, which Anatomists have not used to distinguish into different kinds, till of late Dr. *Willis* has taught that some spirits assist *natural* motion, and others *spontaneous*. Accordingly he makes two Laboratories of these spirits; appointing the Brain for the confection of such spirits as flow into those Nerves that perform *spontaneous* motions, *viz.* such which we are conscious of and can moderate or determine, as the moving of the hand, &c. and the Cerebel for the making of such as flow into those Nerves by which *involuntary* or natural motions are performed, *viz.* such as are done in a constant manner without our knowledge or will, as the pulse of the Heart, &c. To which opinion of his some have made these objections: First, that Fowl have no Cerebel, and yet their Heart, &c. moves. Secondly, The motion of the Heart, called natural, depending

depending (in a great measure) on the influx of the Animal spirits conveyed by the *par vagum* which arise out of the *medulla oblongata*, one cannot easily conceive how the Animal spirits should flow into these Nerves from the Cerebel, and not as well those generated in the brain; or if they entered them alone, why, thirdly, not onely the natural motion of the Heart should be performed by the said pair of Nerves, but voluntary motions also, as those of the *Larynx*, &c. He that would be satisfied of the grounds of Dr. Willis's opinion, may consult his *Cerebr. Anat. capp. 13, 16, 17.*

The fourth Ventricle.

We said a little above, that betwixt the two feet of the Cerebel standing on each side, and the Cerebel it self above, and the trunk of the *medulla oblongata* below, the *fourth Ventricle* was formed, which we need not further describe, onely speak a word of its use; which some have thought to be, for the perfecting of the Animal spirits, (as they were prepared by the three other) and therefore they have called this the *noble Ventricle*. But as was said above of the other three, that they seemed not to be designed purposely by nature, but resulted onely accidentally from the conformation of the circumjacent parts, and served onely as sinks to receive serous humours separated in the glands: so we believe that this results in like manner, and is of the same vile use.

The hinder part of medulla oblongata.

Having now removed the Cerebel from off the trunk of the *Medulla oblongata*, we come to have a view of the *hinder part of the medulla*. Now omitting to speak of the *vertebral arteries* that run up by its sides, (as having mention'd them often before) as also of the pairs of *Nerves* that arise out of it (which we shall describe afterwards) I shall

shall onely in this place take notice of the two medullar pyramidal bodies adhering to its sides. These proceed from the annular protuberance formed about the medulla by the second processes of the feet of the Cerebel, near the basis of the medulla, and being distinct from the rest of the medullar trunk they tend streight towards the spinal marrow, and in their progress by little and little becoming narrower, after about the space of an inch they end into sharp points pyramidal wise, whence they have their name. Dr. Willis thinks them to be ducts or chanel's of the Animal spirits from the annular protuberance, or, which is all one, from the Cerebel, to the Nerves that spring out of the medulla oblongata there whereabout these pyramidal bodies end.

Corpora
pyrami-
dalia.

We have now done with all the parts of the Encephalos, whether relating to the Brain, medulla oblongata or Cerebel, from whence we might proceed to the action of the Brain; but we will first describe the glandula pituitaria seated in the cavity of the wedge-like bone, with the notable plexus of vessels spread about it in some creatures, called Retemirabile; and in the next chapter treat shortly of the spinal marrow as being an appendix or continuation of the medulla oblongata.

This glandula pituitaria has a proper seat of its own made for it in the middle of the wedge-like bone, in a cavity commonly called sella equina. It is not so big in men, as in many other creatures. Its substance is harder and more compact than that of other glands. It is covered with a very thin membrane from the pia mater, proceeding from the infundibulum, and by means of this membrane it is knit very closely to the sella. Upon this gland is poured by the infundibulum that

that ferous humour that is collected in the ventricles of the brain above ; and from this gland it has formerly been supposed to destill through the holes of the wedge-like bone upon the palate, so to be spit out by the mouth. But Dr. *Lower* denies this, appealing to the structure of the parts, and his often experiments upon Calves heads : “ In which, he says, the wedge-like Bone lying under the *Glandula pituitaria* is sometimes perforated in divers places, at least by one large duct, which being divided into two, does on each side open into the Jugular veins : so that if Milk or Ink be injected through those ducts by a Syringe, it presently passeth through on each side into the said Veins ; and nothing of tincture will appear about the Palate, Noftrils, Mouth, *Fauces* or *Larynx*. So that in a Calf the humour that proceeds from the Brain, returns all again into the Veins. And the same thing he says he has lately tried in a Man’s Skull, where in though the wedge-like Bone be never perforated, yet Nature has framed other ducts whereby all the *Serum* may be again derived out of the Ventricles of the Brain into the Blood : for there are two Vessels seated on each side the *Sella Turcica* (to be described Book 6. Chap. 6.) which with gaping Mouths as it were receive all the water distilled out of the *Glandula pituitaria*, and depofite it on each side into the Jugular veins without the Skull ; whose ducts will easily appear if water or milk be squirted forcibly out of a Syringe into either Jugular vein near the Skull, for the liquor will by and by break out near the *Glandula pituitaria* ; which makes it evident, that whatever *Serum* is separated into the ventricles of the Brain, and

"and issues out of them through the *Infundibulum*,
"destills not upon the Palate, but is poured a-
"gain into the Blood and mixed with it.] So
that according to this opinion, the Rheum that
issues so plentifully sometimes into the Mouth and
Fauces, &c. falls not from the Brain, but, as was
noted above, is separated from the Arteries im-
mediately by the Glands of the respective parts.

In those creatures that have the *glandula pitui-* Rete mi-
taria large, (as in Calves, for instance) the two rabile.
Carotid Arteries meeting about the *sella* of the
wedge-like bone presently divide themselves into
small twigs, which being interwoven with like
(though not so numerous) twigs from the internal
Jugular veins, and also with nervous fibres from
the larger trunk of the fifth pair of Nerves, make
on each side a notable *plexus*, called *Rete mirabile*.
There enter into this *Rete* some twigs also from
the Cervical Arteries; and there pass out of it
several twigs into the *glandula pituitaria*. So
that in these creatures that gland seems to be of
the same use to the *Rete mirabile*, as the *glandula*
pinealis is to the *plexus choroïdes*, viz. to separate
a serous matter from the arterial blood. But in
Man (according to the best Anatomists) this *Rete*
is wholly wanting; so that there passing onely
somerimes a twig or two, and sometimes none,
from the trunk it self of the Carotid artery into
the *glandula pituitaria*, that gland is of less use in
him than in other creatures that have the *Rete*.

C H A P. VIII.

Of the Spinalis Medulla.

IT has been our method whensoever we have come to the rise or origine of any part that is extended through several regions of the body, to give a general description of it through its whole extent as if it all belonged to that region where its rise is. Thus, for instance, we gave a general description of all the Arteries of both Head and *Abdomen* as well as of the *Thorax* in our Anatomy of the middle Venter, because they have all of them their rise from the *Aorta* that springs out of the left ventricle of the Heart seated in that Venter. In like manner having described the *medulla oblongata* within the Skull, we shall prosecute it in its descent down the *vertebrae* of the Neck, Back, Loins and *Os sacrum*, wherein it is called the *spinal Marrow*: But this very briefly.

Medulla
spinalis.

We shewed above how its head (the *medulla oblongata*) was joined by the *corpora striata* to the *corpus callosum* of the Brain, as also by those many protuberances that are upon it, both to the Brain and Cerebel from and through which the Animal spirits are derived into it. Its trunk within the Brain (after its *crura* are united) is generally about an hands breadth long: but its length in the spine is very different according to the various statures of men.

Its sub-
stance.

Its *substance* is fibrous (which appears by the help of a microscope) as if it were composed of innumerable slender long filaments, which whether they are hollow or no cannot be discovered through their fineness. If

If one cut through its substance, there will *Vessels* innumerable little specks or sprinklings of blood appear, but the vessels are so small that they cannot be discover'd. But there are plainly discoverable very many twigs of *Arteries* and *Veins* running through the membranes that invest it (being principally branches of the *Cervical*) from which *Arteries* the blood is infus'd into the pores of the *Medulla*, as it is imbib'd again from thence by the *Veins*.

It is round and long, and decreaseth not in its *Figure* thickness by the *Nerves* that go out of it. But on the contrary (as *Dr. Willis* observes) "where the most and the largest *Nerves* spring from it, it is there thickest, as particularly at the rise of the *Brachial* and *Crural Nerves*. Of which he gives this reason, because within the medullar tracts the *Animal spirits* do not run down and pass by swiftly, but for the most part issuing leisurely from their fountains, when they have filled all spaces, they keep their abode in them; and where more spirits are wont upon occasion to be spent on any work, there are provided larger receptacles or store-houses for them.] Only towards its end in the *Os sacrum* it grows smaller and smaller.

It hath three *Membranes*. The first is that *Memo* which immediately cloaths it. This springeth *branes* from the *Pia mater*, and passeth through its middle (dividing it into two parts) alone without the outer. The twigs of *Arteries* and *Veins* run mostly through this. The second covereth the first, and springeth from the *Dura mater*. There is no distance between them, as there is in the *Brain*, but one toucheth another close, being knit together by *Fibres*. The third, proceeding from the *Liga-*

*Its divisi-
on.*

Ligament which tie together the fore parts of the *Vertebrae*, covereth both these.

It is divided all along from the very first meeting of its *Crura* within the Skull, to the end of *Osfacrum*, by a membranous partition parting it into two; but this division is not apparent in the Spine, because of the *Dura mater* that covers it, but it may be discovered if that be taken off, and the *Medulla* severed in the middle. The partition is made of the *Pia mater*, and by means of it it is that the use or motion of *one side* only is sometimes taken away in the Palsie.

As for the *Nerves* that spring out of it, those shall be described after we have done with those of the Brain.

CHAP. IX.

Of the Action of the Brain, and the (Supposed) succus nutritius of the Nerves.

It is generally agreed that the proper *Action* of the Brain (taken in a large sense) is the elaborating of *Animal spirits*; and that they are sent from it by the *Nerves* into the several parts of the Body, for performing both natural and animal actions. But what these *Animal spirits* are, and in what particular part of the Brain they are generated, is not agreed upon by learned Men.

The Animal spirits what, and of what made.

Some are of opinion that the *Animal spirits* differ in no other regard from the *Vital*, but only as they are conveyed by proper *Vessels*, and

and minister to other purposes and are of a cooler temperament ; but that there is no specifical difference betwixt them. Others on the other side think they differ in *specie* and agree in nothing, but onely that the Vital spirits and Blood are the matter out of which the Animal spirits are formed. A third sort deny the Arterial blood to be the matter of these Spirits, and affirm that the Nerves of the Stomach, &c. absorb a part of the Chyle, of which they are made, and besides, a Nutritious juice, (of which by and by.) And some there are that suppose Air also to be an Ingredient, which either ascends into the Brain through the *Os cribriforme*, or insinuates it self into the Blood as that circulates through the Lungs. We cannot stand upon the examination and refutation of several of these opinions here ; but upon a due consideration of the Arguments urged for each, we think that the Animal spirits are specifically distinct from the Vital, but that the Vital, with the Arterial blood, their Vehicle, are the true and only matter, out of which they are elaborated.

And there is no less difference in what part of the Brain the Animal spirits are made. Some deputing to that office the *Sinus* of the *Falx*, others the four ventricles of the Brain, especially the fourth, a third sort the *Plexus choroïdes* and *Rete mirabile* ; *des Cartes* thinks, that they are separated out of the Arteries of *Plexus choroïdes* in the *Glandula pinealis* into the Ventricles ; and others lastly assign the substance of the Brain and Cerebel (especially their Cortical part) for the place of their confection. As to the *Sinus* of the *Falx*, the use of that was shewn above Chap. 3. And as to the Ventricles, seeing they are often almost quite full of waterish humour, but always

Where elaborated.

have *some*, they seem very unfit for the making or storing up such subtile and volatile Spirits as the Animal are. As for the *Plexus choroïdes* and *Rete mirabile*, there is no Vessel that goes out of either which contains any thing but under the form of Blood ; (not to mention that the *Rete mirabile* is wanting in men :) so that seeing there are no *Vasa deferentia* (or call them what you will) to convey the Spirits from these *plexus* to the origine of the Nerves, we cannot reasonably ascribe to them such an action. We must therefore subscribe to the last opinion that ascribes this work to the very substance of the Brain and Cerebel, and is performed in this manner. The Heart is like the *Primum mobile* of the Body, to which the motion of all the humours, that have once past it, is owing. This by its *Systole* impells the Blood, as into all other parts, so into the Brain by the several branches of the *Carotides*, whose innumerable twigs run chiefly through the outer *Cortex* or greyish part of the Brain and Cerebel, and partly into the inner medullar or white substance. These twigs of Arteries spring partly from the *Plexus choroïdes*, and *Rete mirabile* (in those creatures that have it) and partly from the *Carotides* themselves immediately. The superfluous *Serum* is separated from the blood contained in the Arteries before they enter into the Brain and Cerebel, by the Glands above described ; and that Blood which is not elaborated into Animal spirit in these parts, is returned again to the Heart by the Veins. But those particles that are fit and proper to be converted into them, are extravasated into the very *Parenchyma* of the Brain and Cerebel, (*viz.* their Cortical part) or at least are distributed through it by invisible Capillaries,

ries, in which being perfected into Spirits, these by help of the Fibres or Filaments which the inner medullar substance of the Brain and Cerebel chiefly consists of, are conveyed to the *Medulla oblongata* by the *Corpora striata* and other processes whereby the *medulla* adheres to the Brain and Cerebel; out of which *medulla* they enter the Nerves, whose inner substance is fibrous like the *Medulla* from whence they spring. And the reason of this successive motion from one to another, is the Pulse of the Heart, whereby that which comes behind, always drives forward what is before. Whence the true cause of an Apoplexy (wherein motion and sense are almost quite abolished) is very probably from the obstruction or compression, &c. of the Arteries in the Brain and Cerebel; whereby both little Blood and Vital spirit can be conveyed thither to make Animal spirit of, and also when it is made, it is not impelled thence into the *medulla oblongata*, nor out of it into the Nerves, to enable them to perform their functions.

There is no less controversy about the *Nutritious juice* of the Nerves: some contending for it to that height, as to affirm that all the parts of the Body are *onely* nourish'd by it, and not at all by the Blood, which by its rapid motion they say is liker to wear and carry away something from the parts through which it passes, than to adhere to them for their restauration. Others are more moderate, and suppose that nourishment is dispensed onely to the spermatick parts by the Nerves, which the Nerves receive not from the Blood, but imbibing the most thin part of the Chyle out of the Stomach and Guts they carry it up to the Brain, from whence it is conveyed again

The succus nutritius of the Nerves.

by the same or other Nerves to the parts to be nourish'd by it. *Diemerbroeck* is of opinion, that the juice of the Nerves (which is as a Vehicle to the Spirits) being somewhat acid, does contribute or yield assistance to the nourishment of the spermatick parts, not as it is the matter of, but as it separates from the Blood such particles as are fit for, their nourishment. Whence it is, he says, that such parts of the Body as are most exercised, and by consequent into which most Animal Spirits flow, grow the strongest, having more of such particles of the Blood as are fit for their instauration, separated in them. So they that are used to walk, will endure it better, than others that are not so used, though otherwise much stronger. And hence the right Arm is usually stronger than the left, in those that are right-handed (as we say.) But he thinks that the Nerves have no juice in them which they did not first receive from the Blood. *Dr. Willis* is much of his opinion, saving as to this last particular; for he says, it is without doubt that the nervous Fibres and Filaments which cloath the sensory of the taste, and the Bowels that serve concoction, do immediately take some taste of the Aliments for the supply of the Brain, especially at such times as the Spirits are much wasted in too long fasting or over much exercise. But then that juice that may be supposed to be made thereof in the Brain, and to be dispensed by the Nerves into all the parts of the Body, he believes not to be the matter of the nourishment of any part whether spermatick or sanguineous: but that it is as the *form* only, and the Blood the *matter*, whose several particles being analysed or severed by the said juice, are directed and adapted by its *directive faculty* or *plastic*

sick power as it were, to such parts respectively as they are suitable for. And from hence he draws a reason why paralytick parts do waste so much, though the Blood flow plentifully enough into them, because the Nerves being obstructed and no Animal spirits (with their Vehicle) passing by them, the particles of the Blood are not separated for the supply of such parts.] As for the nervous juice, it must needs be very little in quantity, seeing if one make a Ligature upon the Nerve, it will not swell betwixt the Head and Ligature, nor if one cut the Nerve in sunder will any thing distill out of it. So that it seems very absurd to think that it should be sufficient for the nourishment of *all* the parts of the Body, according to the first opinion. Nor does it seem reasonable to imagine that the Chyle should ascend from the Stomach, &c. to the Brain by the Nerves, whiles this nervous juice that is contended for, with the Animal spirits, is descending by the same; for one cannot conceive how such contrary motions of liquors in the same Vessel can be at the same time. Though from the sudden refection that persons ready to faint receive from spirituous liquors, &c. it be probable that certain *Effluvia* or subtil and spirituous vapours do enter the nervous filaments of the Mouth and Stomach, and recruit the Animal spirits immediately, without fetching that compass that I believe all the Chyle does. And as the Nerves imbibe no Chyle from the Stomach, &c. so receive they no more from the Arteries, than some of its most spirituous and volatile particles elaborated in the Brain into Animal spirits, which have indeed some little moisture accompanying them as a Vehicle, but which is neither of a suitable nature nor of pro-

portionable quantity for the nourishment even of the spermatick parts onely. For seeing the Nerves have no conspicuous Cavity, but onely imperceptible Pores, by which any liquor can drill along them; such liquor must needs be most thin and watery, and therefore unfit to be assimilated to any part. And lastly, as to the opinion that it separates the particles of the Bloud, and so distributes those that are respectively proper for, unto, each part, as the sulphureous to the fat, &c. or is to the Bloud as the form is to the matter; it is an ingenious hypothesis I confess, but whether true, I dare not affirm.

C H A P. X.

Of the Nerves arising within the Skull, and first of the first and second pair.

WE have now done with all the parts of the *Encephalos* wherein the Animal spirits are either elaborated or stored up, and have also described the nature of the spirits themselves: it remains that we shew by what and how many Instruments they are dispensed to the parts for the performance of whose functions they are necessary. These Instruments are the *Nerves*, all of which spring either out of the *Medulla oblongata* within the Skull, or out of the *Medulla spinalis* in the spine. They all of them arise by *Pairs*, so that they are not reckoned to be so many *Nerves*, but so many *Pairs* of Nerves. As for the *Pairs* within the Skull, they were formerly reckoned

koned to be but seven, summ'd up in these verses,

*Optica prima; oculos movet altera; tertia gustat:
Quarta, & quinta audit; vaga sexta; at septima
linguae est.*

But stricter examination has found them to be more; Dr. Willis particularly has encreased them to the number of Ten, holding the *processus mammillares* to be the *olfactory* Nerves, and the *Par vagum* and *Intercostale* to be two distinct pairs; and lastly, describing a tenth pair, which descending out of the Skull with the *medulla*, emerges betwixt the first and second *vertebrae* of the Neck. We shall adhere to this account, and describe the *olfactory* and *Optick* in this chapter, and the rest afterwards in order.

Of all the pairs of Nerves that rise within the Skull, the *olfactory* or *smelling* pair arise the foremost, and are therefore reckoned for the first. They spring from the *Crura* of the *Medulla oblongata* betwixt the *Corpora striata* and the little hillocks or eminences out of which the *optick* Nerves rise (called by *Galen*, their *Thalami*.) Though *Diemerbroeck*, that (following the Ancients) denies them to be Nerves, affirms that they spring not from the said *Medulla*, but from the globous marrow of the Brain (properly so called) and its fore Ventricles.

Nervi olfactorii,
the first pair.
Their rise.

From their rise they run forwards under the *Progr* basis of the Brain, (encreasing in bulk as they go) as far as to the *os cribriforme* at the top of the Nose, growing there into round processes like paps, being therefore called *processus papillares* or *mammillares*.

They are manifestly hollow in their whole *pro-* Cavity
gress, *and sub-*
stance.

gress, and their substance is very marrowy and soft.

Insertion.

Having arrived at the *Sinus* of the sieve-like bone, they there acquire coats of the *Dura mater*; with which being clad Dr. *Willis* says they are divided into many fibres and filaments, which pass out of the Skull through the holes in the said bone, into the caverns of the Nostrils, running through the membrane that invests those caverns.

Use.

Dr. *Willis* ascribes a double use to them, making them both the true organs of Smelling, and also Emunctories to the Brain, thinking that when too much serum is collected in its Ventracles these deriving it thence, send it forth by their filaments through the *os cribriforme* into the Nostrils. *Dimmerbroeck* believes they have onely this latter use; onely that the Serum, or *Lympha* distills from them as well upon the *Fauces* and their Glands, as into the Nostrils. Dr. *Lower* grants onely the former; and says, that It is incredible that the
 “humour that is contained in the cavity of these
 “processes should issue out by the Nerves (or
 “*Nervous filaments*) into the Nostrils, for if it
 “did, the sense of Smelling must needs be much
 “prejudic’d thereby. And besides, if this water
 “could distill by and out of the Nerves, much
 “more might the spirits, that are thinner and
 “more subtil, fly away. And as to the humour
 “contained in the cavity of the processes, he
 “supposes it to be of very great use: namely,
 “that when *Effluvia* or most subtil particles ex-
 “haling from an external object are delivered to
 “the *olfactory Nerves*, that their species may
 “reach the Brain the better, it was necessary
 “that those Nerves or *Processes* should be made
 “hollow from their very rise, and be filled with a
 “limpid

"limpid humour : Not that I believe, *says he*,
 "that the species themselves are conveyed
 "through their cavities into the ventricles of the
 "Brain, or that the Animal spirits are lodged in
 "those Ventricles, as the Ancients thought ;
 "but that they are therefore hollow and moisten'd
 "within with water, that their marrowy bodies
 "may serve the better both for retaining and
 "conveying smells into the Brain : For as things
 "smelled are better perceived from moist bodies
 "and in a moist Air than in a dry season from the
 "parched ground (as Huntsmen know too well)
 "so it is likely that in the same manner as they
 "are best perceiv'd outwardly, they are also best
 "conveyed inwardly, &c.] And indeed if we
 will allow them to be olfactory Nerves, (as I
 think there is great reason) it is very incongru-
 ous that they should serve for an Emunctory to
 the Brain, to discharge its superfluous Serum.
 And therefore we think it fit to acquiesce in this
 learned Physicians opinion : and to believe that
 the *Lympha* or *Serum* gathered in the ventricles of
 the Brain is emptied by those ways we before ob-
 served out of the same Author, and not at all by
 the nervous Filaments that pass from these pro-
 cesses through the *Os cribriforme* into the Nostrils.

The second pair are the *Optici* or *Visorii nervi*, *Nervi op-*
 which bestow upon the Eyes the faculty of seeing. *rici, the*
 They spring from the upper sides of those une-^{second}
 qual protuberances of the *crura* of the *medulla ob-*^{pair.}
^{Their rise.}
longata, which are called *Nervorum opticorum tha-*
lami ; from whence being carried forward and
 somewhat downwards, after having fetcht a
 compass they meet one another about the *infun-*
dibulum upon the *sella* of *Os sphenoides* ; where
 they

they are united by the closest conjunction, but not confusion of their Fibres, which run parallel lengthways in these Nerves as they do in all other.

Cavity. They are obscurely *hollow* untill they be united ; but after, their hollownes cannot be discerned. This hollownes may be shewed in a large Beast newly killed, and in a clear light.

Insertion. After their union they are separated again, and each of them running further forwards passes through an hole of *Os cuneiforme*, and is inserted obliquely into the centre of the Eye of its own side.

Vessels. Dr. *Willis* says, they receive not onely nervous fibres from the third pair of Nerves, but also twigs of Arteries from the fore-branches of the *Carotides*, which run upon them as far as the *basis* of the Eye. Whence, he thinks, a reason may be assign'd, why, when a man grows sleepy after plentiful eating or drinking, he presently feels a notable heaviness or oppression as it were about his eyes. For when the blood becoming very turgid fills the vessels that run through the Brain, more than usual, and by distending them stops the pores of the Brain ; these Nerves also in their whole course are compressed by the blood that is become turgid in their blood-vessels likewise.

Substance and parts. They are very soft so long as they are within the Skull, but having past the *os sphenoides* they become somewhat more firm and hard. The reason of which alteration seems to be, that within the Skull they are onely clad with the *pia mater*, but as they go out they assume a second coat from the *dura mater*.

They make the tunics of the Eyes. From the whole substance of these Nerves, viz. from their two membranes and the inner medullary

lar and fibrous substance, are the three (proper) Tunics of the Eyes framed ; for the *Cornea* or *Sclerotica* doth proceed from the *Dura mater*, the *Choroides* or *Uvea* from the *Pia mater*, and the *Retina* from the marrowy substance.

CHAP. XI.

Of the third and fourth Pairs.

THE third pair are termed *Motorii oculorum*, The third pair. because they move the Muscles of the Eyes. They have their beginning at the innermost part *Their beginning* or basis of the trunk of the *Medulla oblongata* behind the *Infundibulum*.

This pair is united at its rise ; whence is commonly drawn a reason why one Eye being moved towards any object , the other is directed also to the same. But though this conjunction may be a reason why the spirits should flow equally to the Muscles of each eye ; yet it satisfies not why they should flow at the same time into different muscles. As for example, why, when one would look to the right side, the spirits are presently determin'd into the *external* muscle of the right eye, and into the *internal* of the left ; and not into the external, or internal of both. And therefore a truer reason of both Eyes being moved together to one object, is the intention of the mind, which aiming onely to have a view of one object at one time, directs the spirits to those muscles onely that serve to turn the Eye towards that object, &c.

Why both the Eyes are directed to the same object.

They

Their sub-
stance and
branches.

They are smaller and harder than the former, and presently parting one from the other they pass along by the optick pair, and penetrating the second hole of *Os cuneiforme*, are carried towards the globe of the Eye, where each is divided into four branches. The first whereof mounting above the Optick, is bestowed upon the attolent Muscle, and the Eyelid. The second is inserted into the adducent Muscle by sundry small twigs. The third by many Fibres is inserted into the depressant Muscle. The fourth passing further in a single trunk is implanted into the middle of that Muscle that draws about the Eye obliquely downwards to the inner corner. At that place where this Nerve divides it self into four branches, it forms a little round *plexus*, out of which many slender twigs arise that creep through the trunk of the Optick Nerve, serving perhaps to widen or straiten it as there is occasion.

The fourth
pair.

Their be-
ginning,
march and
Insertion.

The fourth pair proceed from the top of the *Medulla oblongata*, (contrary to all others, which arise either from its *basis*, or *sides*) behind the round protuberances called *Nates* and *Testes*: whence bending forwards by the sides of the *Medulla oblongata*, they presently hide themselves under the *Dura mater*; under which proceeding a while, they pass out of the Skull each in a single trunk at the same hole with the others designed for the Eyes, (communicating with no other Nerves in their whole progress) and are bestowed wholly (as Dr. *Willis* affirms) on that Muscle of the Eye called *Trochlearis*, which serves to rowl the eye about. Which motion of the Eye being generally attendant upon or expressive of some passion of the mind, as Love, &c. these Nerves are thence called *Oculorum pathetici*.

C H A P.

C H A P. XII.

Of the fifth, sixth, and seventh Pairs.

THE fifth pair spring from the sides of the *me- The fifth*
dulla oblongata where it is encompassed with *pair.*
the annular process or protuberance of the Cere- *Their rise.*
bell, (or as Dr *Willis* will have it, from that pro-
cess it self.) Each trunk is very large and broad,
consisting of very many Fibres, some soft and
some hard : so that it seems to be not one single
Nerve, but a collection or bundle of many small
ones, some of which are designed for one part,
some for another ; some serving for motion and
others for sense. And the reason why they are
all united together in their rise, the said Authour
thinks to be, that there may be a sympathy and
consent of actions in the several parts to which
they are distributed. Whence it is that seeing or
smelling what is pleasing to the appetite makes
ones Mouth water, &c. because this pair of
Nerves send twigs both to the Eyes, Nostrils, Pa-
late and Tongue, &c.

Each trunk is divided into *two* notable branch- *Division*
es, sometimes before but oftener after it has pe- *and pro-*
netrated the *Dura mater*. The first whereof ten- *gress.*
ding streight downwards, and passing out of the
Skull by its proper hole, in its descent towards
the lower Jaw (for whose parts 'tis chiefly de-
sign'd) is divided into many lesser branches, which
provide for the temporal Muscle, as also for the
Muscles of the Face and Cheeks. From these al-
so there go twigs to the Lips, Gums, roots of the
Teeth, Fauces, Tonsils, Palate and Tongue.
The

The *second* branch of this fifth pair, being the larger, goes a little streight forward by the sides of the *jella Turcica*, and over against the *Glandula pituitaria* sends little twigs to the trunk of the *Carotides*, or to the *Rete mirabile* in such creatures as have it : then inosculates with the Nerve of the sixth pair, and afterward sends back a slip or two, which being united with another slip returned from the Nerve of the sixth pair constitute the root or first trunk of the *Intercostal pair*, which we shall reckon for the ninth, and speak of it by and by. After this it is divided into *two* notable branches ; The *less and upper* whereof tends towards the globe of the Eye, and being again divided sends forth two other, the first of which is parted into two more, that go one to the Nose and the other to that Muscle of the Eye which is proper to Brutes ; and the second into four or five slips, that are mostly spent on the Eye-lids, but partly on the *Uvea tunica* and the Glands of the Eye. The *greater branch* (of its second division) being carried towards the orbit of the Eye is divided into two new branches. The *lower* whereof bending downwards is bestowed on the Palate and upper region of the *Fauces* ; and the *upper* being carried beyond the orbit of the Eye passes through an hole of the upper Jaw with the Vein and Artery which it twists about, and sends many slips to the Muscles of the Cheeks, Lips, Nose, and roots of the upper Teeth. From its twisting about the sanguiferous vessels designed for the Cheeks and other parts of the Face, may a reason be drawn why one blushes when he's ashamed : for the Animal spirits being disturbed by the imagination of some uncomely thing, as if they took care to hide the Face,

Face, enter this Nerve disorderly; so that its twigs embracing these sanguiferous vessels, by compressing and pulling of them, cause the Blood to flow too imperiously into the Cheeks and Face by the Arteries, and detain it there some time by constringing the Veins.

The *sixth* pair rise just by (but below) the fifth, and each presently sinking under the *Dura mater* goes out of the Skull by the same hole with the Nerves of the third and fourth pair, and is carried by a single trunk towards the orbit of the Eye; but so, as by the side of the *sella Turcica* it inosculates with the second or greater branch of the fifth pair, (as was noted in the former paragraph :) whence sending back sometimes one, sometimes two twigs, these being united with the recurring twigs of the fifth pair (above-mentioned) make the beginning of the *Intercostal nerve*. Afterwards going forwards, near the orbit of the Eye it is divided into two branches; of which *one* is inserted into the abducent Muscle of the Eye placed in its outer corner; and the *other* being cleft into many Fibres is bestowed on the seventh Muscle proper to Brutes, whereby they defend the Eye from external injuries accidentally occurring, when they are said *nictitare*, (which I think we have no word to express in English.)

The *seventh* pair, by the Ancients commonly reckon'd for the fifth, minister to the sense of Hearing. Each Nerve has two Processes, one soft, and the other harder, which might seem to be two distinct Nerves, but they are usually accounted for one. They spring a little behind the former, out of the sides of the *Medulla oblongata*. Dr. Willis says, the *softer* process arises from the lower side of the annular protuberance, from whence

*The sixth pair.
Their rise and insertion.*

*The seventh pair.
Their rise and insertion.*

whence it ascends; and the *harder* from its upper part, from whence descending it meets the other. The *soft* part or process (that is properly the auditory Nerve) is carried through an hole of *Os petrosum* into the cavern of the Ear, which it cloaths with a most thin Membrane. By this are sounds conveyed to the common sensory. The *harder* process serves rather for motion than sense; which passing out also through the *os petrosum* by its proper hole, presently admits a twig from the *par vagum* or eighth pair, after which it is immediately divided into *two* branches; one whereof tending downwards, is bestowed on the Muscles of the Tongue and *Os hyoides*; and the other winding about the auditory passage, and bending upwards, is divided into three twigs; of which the *first* corresponding to the Nerve of the first division bestows certain slips on the Muscles of the Lips, Mouth, Face and Nose, and so actuates some outward organs of the Voice, as the former some of the inner; the *second* is distributed to the Muscles of the Eye-lids and Forehead, and the *third* on the Muscles of the Ears. Whence upon some unusual and astonishing sound, by a certain natural instinct the Ears prick up and the Eyes open. As also the voice does officiously answer as an Echo to those sounds that are perceived by the Ears, from the community of the Nerves distributed to the organs of the voice and hearing.

C H A P. XIII.

Of the eighth, ninth and tenth pairs.

THE next pair in order is the *eighth*, which *The eighth* has used to be reckoned for the sixth, and *pair.* is otherwise called *par vagum*, or the *wandering pair*, from their being distributed to sundry parts.

They spring below the auditory Nerves, out *Their rise.* of the sides of the *Medulla oblongata*, the root of each Nerve consisting of twelve Fibres at least (in Man,) to which a notable Fibre, or rather Nerve (much greater than any of these twelve) coming from the spinal marrow as far as from about the sixth or seventh *vertebra* of the Neck, is joined, and both are invested with the same Coat from the *Dura mater* as if they grew into one Nerve; but if their common Coat be removed, this accessory Nerve, and many of the other Fibres remain still distinct, and after they are gone out of the Skull together, are dispensed to several parts; the accessory Nerve to the Muscles of the Neck and Shoulder-blade; and one notable Fibre of the eighth pair to the harder process of the Auditory or seventh pair, as also two others to the Muscles of the Gullet and Neck. But the other fibres of this *par vagum* continue united, and instead of those companions they have parted with, each Nerve entertains a new one, namely a branch from the *Intercostal* or *ninth* pair, whereby is made a notable *Plexus* (which in a Nerve is like the joynt of a Cane, or the knot upon the trunk of a Tree where a Bough goes out, whence they are called *ganglioformes*) and

C c

out

Progreſs.

out of the ſame *Plexus* there ſprings a conſiderable branch, which being carried toward the *Larynx* is divided into three twigs, of which one goes to the ſphincter of the Gullet, a ſecond to the upper Muſcles of the *Larynx*, and the third going under the *Cartilago ſcutiformis*, meets the top of the recurring Nerve and is united to it. Below the aforeſaid *Plexus* of this *par vagum*, each trunk goes ſtreight down by the ſides of the aſcending *Carotides*, on which they beſtow ſome ſlips. And at the bottom of the Neck each receives a ſecond branch from the Intercostal, (*viz.* from its firſt *Plexus*) and near thereto the left Nerve of this pair ſends out another twig into the recurring Nerve, but ſo does not the right. From hence both trunks deſcend without any notable ramification, till they be come over againſt the firſt or ſecond Rib; where out of a ſecond *Plexus* (or knot) many twigs and Fibres go towards the Heart and its appendage, from whence this *Plexus* is called *Cardiacus*. There is one notable difference (which we cannot but note) of the two recurring Nerves that ſpring out of the trunks of this eighth pair, *viz.* that that on the right ſide ariſes out of it higher and windes about the axillar Artery; whereas that on the left ſprings much lower therefrom, and twiſting about the deſcending trunk of the *Aorta* returns back from thence. Dr. *Willis* ſays that the recurring Nerve is really a diſtinct Nerve from the *par vagum* from the very original, and waſonely included in the ſame caſe or cover for the more convenient and ſafe paſſage. The branches of the *par vagum* do frequently unite with others of the Intercostal pair about the *Præcordia*. And when their two Trunks are deſcended as low as over againſt the heart, many
twigs

twigs go out of them into the Lungs, &c. Whence both trunks descending by the sides of the Gullet are divided into two branches, *outer* and *inner*: The *outer* unite with the *outer*, and the *inner* with the *inner*, and both descend to the Stomach, in which they terminate, but are spent chiefly upon its upper orifice. As for their more particular distribution, we have spoke thereof while we treated of the parts themselves on which they are bestowed. End.

We are next to describe the *ninth pair* (which before Dr. Willis was not distinguished from that pair going before.) It is called the *Intercostal*, because as its Trunks march down by the roots of the Ribs, betwixt every Rib they receive a branch from the spinal marrow. They have no proper root of their own, but each trunk is compounded of two or three recurring branches of the fifth and sixth pairs, (near their origine) as was noted when we treated of those pairs. Being thus formed they pass out of the Skull by their proper holes, and presently each has a *Plexus* near those of the *par vagum*, into which two nervous processes from the tenth pair of the brain are inserted, and out of which there goes a twig into the sphincter of the Gullet, and into the *Plexus* (aforesaid) of the *par vagum*. Whence descending by the *vertebrae* of the Neck, by that time they arrive at its middle, each has another greater *Plexus*, into which a large Nerve from a neighbouring vertebral pair is inserted; and from which proceed many twigs that uniting with others of the *par vagum* are distributed all about the *Præcordia*, as also one single one a little lower. This *Plexus cervicalis* out of which so many branches spring is Their rise.
Progress.

per to Man, being not found in Brutes. From the Neck they descend by the *Claviculæ* into the *Thorax*, where having arrived at the second Rib each receives three or four branches from the vertebral Nerves next above, whereby is made another notable *Plexus* (commonly called the *Intercoſtal*.) From whence as they paſs down by the roots of the Ribs, in every one of their Interſtices and even as low as *Os ſacrum*, from every jointing of the *vertebræ* each receives a vertebral branch. Aſſoon as they are deſcended out of the cavity of the Breſt, and are come over againſt the Stomach, each ſends forth a notable branch, which tending towards the Meſentery, make its chief *Plexus*, which are in number ſeven, five large ones which are upper, and two leſs that are lower. For each branch is pretently divided into two other, and every one forms one *Plexus*, which make four; and the fifth is in the middle of theſe, being the largeſt, and like the Sun amongſt the Planets (as Dr. *Willis* compares it.) And theſe are the five upper. The two lower are framed of branches that ſpring from the trunks deſcended as far as the lower part of the Loins, and are diſtinguiſhed by the names of *Plexus Inſimus*, and *Minimus*. As to the parts that all the twigs which ſpring from theſe ſeven *Plexus* are diſtributed to, it may be learned from the deſcription of the parts themſelves in the *firſt Book*, in which we conſtantly mentioned from whence each part had its Nerves. Laſtly, when this Intercoſtal pair is come to the *Os ſacrum*, its two trunks bend towards each other, and ſeem to be knit together by two or three proceſſes, and at length each of them ends in ſmall Fibres that are diſtributed into the ſphincter of the *Anus*.

End.

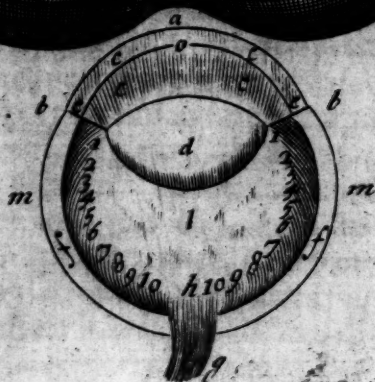
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Fig. I.



Fig. 2.



We are now come to the *tenth* and last pair of *The tenth* Nerves that rise from the *medulla* within the Skull. *pair.*
 This pair spring from the sides of the *medulla*, be- *Their rise*
 hind all the rest, and descending with it out of the *and pro-*
 Skull into the *vertebræ* of the Neck, they come out *gress.*
 betwixt the first and second *vertebræ* thereof. Pre-
 sently after their egress each sends forth a branch
 into the *Plexus* of the Intercoastal Nerve of its own
 side: but their main trunks being carried down-
 wards, and each receiving a twig from the ninth
 pair, they are bestowed on the Muscle *sternorhy-*
noideus, and some other Muscles of the Neck;
 so that though this pair rise within the Skull,
 yet it seemsto be more of the nature of the Ver-
 tebral Nerves, as bestowing some branches on the
 Intercoastal, and being all the rest of it spent upon
 the Muscles of the Neck.

And thus we have done with all the Nerves
 that proceed from the *Medulla* within the Brain,
 in describing of which we have followed Dr. *Willis*
 for the most part, that most accurate tracer of
 them.

Tab. XIV.

Fig. 1. Representeth the outer or upper superficies
 of the Brain taken out of the Skull; where the
Limbus of the Brain being loosed from its co-
 herence with other parts by Membranes, is
 lifted up and bent forwards, that the *Crura* of
 the *Medulla oblongata*, the *Fornix*, *Nates* and
Testes with the *Glandula pinealis*, and other pro-
 cesses may be clearly and distinctly seen, (from
 Dr. *Willis*.)

AA The Limbus of the Brain, which in its natural
 C c 3 situation

- situation was contiguous to the Cerebellum.
- B** The bordure or margent of the Corpus callosum spread over both hemispheres of the Brain, which in its natural situation lay upon the Glandula pinealis.
- C** The Fornix.
- DD** Its Arms embracing the Crura of the Medulla oblongata.
- EE** The Crura of the Medulla oblongata, (out of which the optick Nerves proceed) whose ends (being placed further, out of sight) are called Corpora striata.
- F** The Glandula pinealis, betwixt which and the root of the Fornix is the chink that leads to the Infundibulum.
- GG** The orbicular protuberances called Nates.
- HH** The lesser protuberances called Testes, which are processes of the former.
- II** The Medullary processes, which ascend obliquely from the Testes to the Cerebellum, and make a part of each of its Meditullia.
- K** The joining of those processes by another transverse process.
- L** The rise of the pathetick Nerves (or fourth pair) out of the joining of the foresaid processes.
- MM** A portion of the Medulla oblongata lying under the foresaid processes and protuberances.
- N** The Foramen of the Ventricle or cavity that lies under the orbicular protuberances.
- OO** A portion of the annular protuberance let down from the Cerebellum and embracing the Medulla oblongata.
- PP** The outer and upper superficies of the Cerebellum.

Figure II.

Representeth the Eye cleft in two (from behind forwards)

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Fig. I.



Fig. 2.



Fig. 3.



Fig. 4.



Fig. 5.



ab. x forwards) that the divers situation of the humours may appear, (from Dr. Briggs.)

ba b The Tunica cornea, or fore and more convex arch of the Eye.

cc The Tunica uvea (whose Foramen o is called the Pupilla) swimming in the watry humour cccc.

d The crystalline humour in situ.

ff The Tunica choroides, which in this Figure (as being too much separated from the Sclerotica m m) cannot be duly represented.

A portion of the Optick Nerve.

Some of its small Fibres cut off near the exit of the Nerve.

The centre of the Humor Vitreus, and of the Retina.

3, 4, 5, &c. The Capillamenta of the optick Nerve, whose ends on each side being cut off did adhere to the Ligamentum ciliare (namely by the region of the crystalline humour.)

Table XV.

Fig. 1. Representeth the basis of an humane Brain taken out of the Skull, with the roots of the Vessels cut off short, (from Dr. Willis).

AAAA The fore and hinder Lobes of the Brain.

BB The Cerebellum.

CC The Medulla oblongata.

DD The olfactory Nerves, or first pair.

EE The optick Nerves, or second pair.

FF The motory Nerves of the Eyes, or third pair.

GG The pathetick Nerves of the Eyes, or fourth pair.

HH The fifth pair.

II The sixth pair.

C c 4

KK kk The

- KK *kk* The auditory Nerves, and their two Processes on each side, the seventh pair.
- LL III, &c. The Par vagum or eighth pair, consisting of several Fibres.
- MM The spinal Nerve coming from a far to the origine of the Par vagum.
- NN The ninth or Intercostal pair, consisting also of many Fibres (that tending downwards, unite into one trunk) which emerges a little above the process of the Occiput.
- OO The tenth pair tending downwards.
- PP The trunk of the Carotid Artery cut off, where it is divided into the fore and hinder branch.
- QQ Its branch passing betwixt the two lobes of the Brain.
- R The fore branches of the Carotides, being united, part again and proceed to the fissure of the Brain.
- S The hinder branches of the Carotides united, and meeting the vertebral trunk.
- TTT The vertebral Arteries, and their three ascending branches.
- U The branches of the vertebral Arteries uniting into the same trunk.
- WW The place where the vertebral and Carotid Arteries are united, and a branch on either side ascends to the Plexus choroides.
- X The Infundibulum.
- YY Two Glands placed behind the Infundibulum.
- aaaa The annular protuberance which proceeding from the Cerebellum embraces the trunk of the Medulla oblongata.

Fig. 2. exhibits a side-view of the Anvil and Stirrup (two bones in the first cavity of the Ear) *in situ*, from Mons. du Verney.

A The thick part of the Anvil.

B The

- B The short branch which in this situation we behold fore-right.
- C The long branch.
- D The head of the stirrup which is joined with the long branch, the fourth little bone coming between.
- E The Muscle that is inserted into the head of the stirrup.

Fig. 3. represents the Hammer (a third bone in the same cavity) on its fore-side with its Muscles *in situ*, from the same Author.

- A The head of the Hammer.
- B The handle.
- C The external muscle of the hammer.
- D Its insertion.
- E The internal muscle.
- F The place where it is fitted for its insertion into the handle of the hammer underneath the external muscle.
- 1. The great process of the hammer in a direct view.
- 2. The slender process into which the external muscle is inserted.
- 3. 4. The nervous covering of the internal muscle opened in the middle, that the muscle may be seen.

Fig. 4. shews a portion of the vestibulum or entrance of the Labyrinth (a second cavity of the Ear) with its three semicircular canals, from the same Author.

- A The lower part of the vestibulum.
- B The upper canal.
- C The lower.
- D The middle,

1. The entrance of the upper semicircular canal.
2. The first entrance of the middle canal.
3. The entrance of the lower canal.
4. The other entrance of the middle canal.
5. The common entrance to the upper and lower canals.
6. The first hole that gives a passage to one of the branches of the soft part of the auditory Nerve.
7. The second hole that gives a passage to another branch of the same Nerve.

Fig. 5. shews the *cochlea*, which the foresaid Author makes a part of the Labyrinth, but other Anatomists call a third cavity.

C H A P. XIV.

Of the Nerves of the Spinalis medulla; and first of the Nerves of the Neck.

WE observed above, that when the *Medulla oblongata* is descended out of the Skull into the Spine, it loses its name of *oblongata*, and acquires that of *Spinalis*, (which name it borrows from the Spine through which it passes) but is of the same fibrous or filamentous substance as it was within the Brain. And now we come to describe the Nerves that spring out of it, which assist the motion of all those parts, which those ten pair already described, that arise within the Skull, reach not to.

*Nerves
springing
from the
Spinalis
medulla.*

In its whole progress from the Skull to the *Coccyx*, there spring out of it *thirty* pair of Nerves: *seven*

seven of which are of the Neck, twelve of the Thorax, five of the Loins, and six of Os sacrum.

The first and second pair of the Neck come not out of the sides of the Vertebrae, as all the rest do; but because of the peculiar articulation of the two uppermost vertebrae spring out before and behind.

The fore Nerve of the first pair cometh out between the bone of the Occiput and the first vertebra of the Neck, and is bestowed upon the Muscles of the Neck which lie under or behind the Oesophagus, and on the skin of the Face. The hinder Nerve cometh out of the hole which is common to the Os occipitis and the first vertebra of the Neck. This hath two twigs: The smaller is bestowed upon those Muscles which lie upon the Occiput, and upon the skin of the Head as high as the Crown; The bigger is inserted into the Muscle which lifteth up the Shoulder-blade.

Seven of the Neck.
The first pair.

The fore Nerve of the second pair (which is smaller) cometh out between the first and second Vertebrae, and is bestowed upon the Skin of the Face. The hinder cometh out of the sides of the hinder process of the second Vertebra, but presently is parted into two twigs. The thicker of which is bestowed upon the whole Skin of the Head even to the Crown; The smaller upon the greater streight, and the lower oblique Muscles which stretch out the Head. Dr Willis says, that the first and greatest root of the Nerve of the Diaphragm ariseth from the second pair of the Neck: of which Nerve we shall speak more by and by.

The second.

The five remaining pairs of the Neck, as also all the pairs of the Back and Loins, and the first of Os sacrum, come out of the lateral holes betwixt the Vertebrae, and immediately after their exit

exit are divided into the *fore* and *hinder* branches, and are distributed as followeth.

The third. The *third* pair come out of the *lateral* holes between the second and third *Vertebrae*, and each being immediately divided into two branches, the *formore* thereof have each four twigs: The first is inserted into the *long* Muscle, or the first of the benders forward of the Neck; The second descending is bestowed upon the Muscles which lie under the *Oesophagus*, being first united to a twig of the fourth pair; The third ascending goeth to the Skin of the back-part of the Head, having first joined with the thicker twig of the hinder Nerve of the second pair; The fourth is bestowed upon the transverse Muscles of the Neck, and the Muscle which lifteth up the Shoulder-blade. The *hinder* branches are bestowed upon the second pair of Muscles which heave up or widen the Breast.

The fourth The *fourth* pair come out of the holes common to the third and fourth *Vertebrae*, the *formore* branches whereof are each divided into three twigs: The first of which uniting with a twig of the third pair is bestowed on the first of those Muscles which bend the Neck forward called *Longus* (as above said;) The second upon the transverse Muscle of the Neck, and the *Cucullaris* of the Shoulder-blade: The third being slenderer than the other two, is joined with a twig of the fifth pair, and both with one of the sixth, and lastly all three (according to Dr. *Willis*) with that of the second pair above-mentioned: and the Trunk made up of all these descendeth by the sides of the Gullet down the Neck and *Thorax* without any branchings till it come to the Diaphragm, where it is divided again into three or four twigs,

Nervus
phrenicus.

on each side, and is inserted into its fleshy or muscular part, being known by the name of *Nervus diaphragmatis*, or *Phrenicus*, (of which we have discoursed more largely in Book II. chap. 3. of the Midriff.) The *hinder* branches go back to the Spine under the Muscles of that part, upon which they bestow twigs, and going down between the Muscles of each side of the Neck, each is carried to the *Musculus quadratus* of its own side that draweth the Cheek down.

The *fifth* pair issue out between the fourth and fifth *Vertebra*, the *formore* branches whereof have each four twigs: The first goeth to those Muscles that bend the Neck forward: The second is that which joineth with the twigs of the second, fourth and sixth pairs, and makes up the *Nervus phrenicus*: The third goeth to the Muscle *Deltoides*: The fourth goeth to the same *Deltoides*, and to the *Coracobyoideus*, or the third Muscle of the *Ombryoides*. The *hinder* branches bend back to the Spine, and are bestowed upon the Muscles there, as the like branches of the fourth pair were.

The *sixth* pair come out between the fifth and sixth *Vertebra*. Their *formore* branches send forth first one twig to make the trunk of the *Nervus phrenicus*; then proceeding further they are united with the like branches of the three following pairs, namely the last of the Neck and two first of the *Thorax*, making on each side one *Plexus* with them, out of which those Nerves proceed that are carried to the Arms. The *hinder* branches go to the Muscles behind, which stretch out the Neck and Head, or bend them backward.

The *seventh* pair come out of the holes common to the sixth and seventh *Vertebra*. The *venth* for-

more and larger branches are joined with the like of the sixth of the Neck and two first of the *Thorax*, as aforesaid, furnishing Nerves to the Arms. The *binder* and smaller are bestowed upon the Muscles of the Neck, and quadrat Muscles which pull down the Cheeks.

Nervus ad
par va-
gum ac-
cessorius.

About where these sixth or seventh pairs of Nerves rise, there spring on each side another Nerve, described by Dr. *Willis*, and by him called *Nervus spinalis ad par vagum accessorius*. They rise small out of the sides of the spinal marrow, and ascend up by the sides of it, growing thicker as they goe, (but without being inserted any where into the marrow) till having enter'd the Skull they are joyned to the Fibres of the *par vagum* or eighth pair. Their progress from thence we observed in Chap. 13. when we described the eighth pair.

CHAP. XV.

Of the Nerves of the Vertebrae of the Thorax.

Twelve of
the Tho-
rax.

FROM the marrow of the *vertebrae* of the *Thorax* spring twelve pair. In all of which the former branches are bigger; and the hinder which are bestowed upon the Muscles seated on the Back, smaller.

The first
pair.

The *first* pair spring out of the lateral holes which are common to the seventh *vertebra* of the Neck, and the first of the *Thorax*, and therefore 'tis indifferent whether they be esteemed to belong to the Neck or *Thorax*, some reckoning them to be

be the eighth pair of the Neck, and others (as we do here) the first of the *Thorax*. Each Nerve is presently divided (as all the rest are) into two branches; the *formore* of which are united to the like branches of the sixth and seventh of the Neck as was noted in the foregoing Chapter, and so are all spent on the Arms, except one little twig that springing out of the beginning of each marcheth forward towards the *Sternum*, and bestoweth twigs on the *Musculus subclavius*, and those Muscles which arise from the top of the *Sternum*; and another that goes to that Muscle which fills up the hollowness of the Shoulder-blade. The *binder* branches creeping under the Muscles which cleave to the *Vertebrae*, are bestowed upon the Muscles of the Neck, Head and Shoulder-blades.

The *second* issue out of the holes between the first and second *vertebrae* of the *Thorax*, the *fore* branches whereof are united with the like of the first of the *Thorax*, and together with them are joined to the *fore* branches of the sixth and seventh of the Neck, and these all together make one *Plexus* on each side that sendeth forth all the Nerves to the Arms that they have, (as shall be further explained Book 4. Chap. 3.) But before the *fore* branches of this pair unite with the others, each sends a twig also to the Intercostal nerve (or ninth pair) descending down the *Thorax*, (as also does every one of the remaining ten pair) and from that twig before it join with the Intercostal there proceed small slips to the Muscles that lie upon the *Thorax*. The *binder* branches have the same distribution with the hinder of the foregoing pair.

The rest of the ten pair come out of the lateral holes The rest of the pairs.

holes betwixt the *Vertebrae*, and are all immediately divided on each side into two branches; whereof the *formore* being larger, always send each of them one twig to the Intercoſtal nerve, and the remainder of them is beſtowed on the Intercoſtal Muſcles internal and external, and on thoſe that lie on the *Thorax*; as alſo on the obliquely deſcending Muſcles of the *Abdomen*, &c. The *binder* bend backward to the Spine, and are ſpent upon the Muſcles and Skin of the Back.

CHAP. XVI.

Of the Nerves of the *Vertebrae* of the *Loins*.

Five of the
Loins.

OUT of the Marrow contained within the *vertebrae* of the *Loins*, ariſe five pair of Nerves. The *fore* branches being greater go to the Muſcles of the Belly: The *binder* to thoſe which reſt upon the *Vertebrae*. The *formore* (as *Spigelius* affirms) are joined together, the firſt with the ſecond, the ſecond with the third, the third with the fourth, and the fourth with the fifth, as the two laſt of the Neck and two firſt of the *Thorax* were.

The firſt
pair.

The *firſt* pair come out of the lateral holes between the laſt *vertebra* of the *Thorax*, and the firſt of the *Loins*. The *fore* branches are beſtowed upon the fleſhy part of the Midriff, eſpecially its hinder proceſſes that are knit to the *vertebrae* of the *Loins*, and on the Muſcles *Pſoæ*. Whence when there is a large ſtone in either kidney, (the lower ends of the kidneys reſting upon the heads of theſe Muſcles) this Nerve is compreſſed thereby,

by, and from thence is a numbness extended to the thigh of that side, because these Muscles terminate in the thighs. These *fore* branches do each of them also send a twig along with the *Arteria preparans* to the Stone, according to *Spigelius*. From whence it is, partly, that too immoderate Venery causeth a weakness in the Loins. The *binder* are bestowed upon the *Musculus longissimus* of the Back, *Sacrolumbus*, &c.

The *second* come out between the first and second *vertebræ* of the Loins, under the Muscles *Psoæ*, (which are the first pair of those that bend the Thighs) The *formore* branches are bestowed upon the second pair of those Muscles that bend the Thighs, which fill up the cavities of *Ossa Ilea*, and on the *Musculi fasciales* and the Skin of the Thighs. The *binder* are bestowed upon the *Musculi glutæi*, and the membranous pair of Muscles which extend the Leg. Each of those twigs which from this pair join with the Intercoastal, goeth to the *Testis* of its own side (according to *Vesalius*, &c.)

The *third* pass out of the holes between the second and third *Vertebræ*, under the *Psoæ* also. The *formore* branches each of them send one twig to the Knee and the Skin thereof, and another which doth accompany the *Saphæna* down the Leg. The *binder* turn back, and are bestowed upon the Muscles which rest upon the Loins.

The *fourth* issue out between the third and fourth *Vertebræ* being the largest of the Nerves of the Loins, and marching under the *Psoæ* and *Ossa pubis*, accompany the Crural Veins and Arteries.

The *fifth* come out between the fourth and fifth

fifth *Vertebra*. The fore branches pass through the holes that are between the bones of the *Coxendix*, *Pubes* and *Ileum*, (one on each side) and are bestowed upon the *Obturatores musculi* of the Thigh, the Muscles of the *Penis*, and on the neck of the Bladder, and of the Womb. The *binder* are bestowed upon the Muscles and Skin which lie upon the *Vertebra*.

CH A P. XVII.

Of the Nerves which arise from the marrow of Os sacrum.

Six of Os
sacrum.
The first
pair.

FROM the marrow of *Os sacrum* six pair of Nerves spring.

The first issue out between the last *vertebra* of the Loins, and the first of *Os sacrum*, in the same manner as those that spring out of the *vertebra* of the Loins, and like them are each divided into two branches. The fore branches are a great part of them mixed with those other of the Loins that go towards the Thighs, yet each sends forth a twig that is dispensed to the Muscles of the Belly, and to the second bender of the Thigh. The *binder* are bestowed upon the Skin of the Buttocks, and the greatest *Glutæi*.

Of the o-
ther five
pair.

The other five pair spring after a different manner from the foregoing. For before they come out of the *Os sacrum*, they are every of them double on each side; and so from each on either side there arise two Nerves, one of which is carried into the fore or inner, and the other in-

to the hinder or outer side. The three uppermost Nerves go towards the Thighs, as the greatest part of the first pair did: The two lower to the Muscles of the Anus and Bladder; in Men to the Penis, in Women to the neck of the Womb, and in both to the external Privity. All the five hinder Nerves are distributed to the Muscles of *Ossa Ilea* and *sacrum*, towards the back part, which are *Longissimi*, *Sacro-lumbi*, *Sacri*, and the *Glutaei*.

How the *Brachial* and *Cervical* Nerves are formed out of the Nerves of the Spine, shall be more particularly, but briefly shewn in the next Book.

And thus we have done with all the thirty pair of Nerves that arise out of the *Spinal marrow*, having shewn which way they pass and to what parts they are distributed: which should be diligently noted, that we may the better know to what place to apply remedies when from any outward cause, as from a fall, bruise or the like, any part has lost either sense or motion, or both. For the Medicine is to be applied always to the beginning or rise of that Nerve that passes to that part, and not to the place in which the symptom appears. And the same thing is to be observed in Palsies, when the use of some particular Limb is taken away from an inward cause.

Having finished our discourse of the vessels that spring from the *Spinal marrow*, we will add a word to what was said above, ch. 8. of the blood-vessels that are dispersed through it, from Dr. Willis. These are of three sorts, *Arteries*, *Sinus* and *Veins*. It is supplied with *Arteries* after one manner above the Heart, and after another below it. For above it, seeing the trunk of the *Aorta* is presently cleft into many branches, which depart from the spine,

The blood-vessels of the spinal marrow.

fore from its Axillar branches there springs a *Vertebral Artery* on each side, which ascending streight to the *Occiput*, sends a twig in at every jointing of the *vertebræ*: But below the Heart, inasmuch as the *Aorta* in its whole descent lies upon the spine, there are received into the spine two Arteries from its back side, betwixt every jointing of the *vertebræ*. But both above and below, the Arterial branches that are carried toward the spine, being presently divided each into two, one twig is bestowed on the neighbouring Muscles, and the other enters in at the jointing of the *vertebra*, within whose cavity it is subdivided into three other twigs, two of which are bestowed on the *Medulla* (with its two membranes) and the third on the membrane that lines the inside of the *vertebra* before. How these branches of Arteries inosculate with one another, may better be conceived by the said Author's draught of them in his *Tab. 12.* than by a verbal description, I therefore remit the Reader thither. The *Sinus*, he says, are continued from the lateral *sinus* of the Brain, and all along the spinal marrow they lie under the Arteries, having one vessel to receive the blood from the Arteries and another to deliver it to the Veins, serving for the same uses as those of the Brain did, which were shewn above in chap. 3. of this Book. Its *Veins*, like the Arteries, are communicated to it different ways above, and below the Heart. Above, a branch arising from the trunk of *Vena cava* below the subclavian, accompanies the Vertebral Artery up to the *Occiput*, sending a twig in at every jointing of the *vertebræ*: but below the Heart, because the trunk of *Vena cava* does not, like the *Aorta*, lie immediately upon the spine, and so cannot immit twigs into it directly,

directly, therefore it sends out of it self *Vena sine pari*, out of whose trunk two branches springing, and each of those being divided into two, one of them is bestowed on the neighbouring Muscles, and the other enters the spine. Yet below the kidneys, when there is lieve given to the *Vena cava* to be carried near the spine, the *Vena sine pari* ends, and the *vasa Lumbaria* proceed immediately from the trunk of the *Vena cava* as well as from the trunk of the great Artery. The branchings of the *Sinus* and *Veins* within the spine and their *anastomoses* are curiously delineated in the aforesaid *Tab. 13.* which deserves to be consulted by the Reader.

CHAP. XVIII.

Of the Face and its parts.

IN the former chapters we have discoursed of that part of the Head that is decked with Hair, called *Calva*, of the Brain, &c. contained within it, of the *Medulla oblongata* arising out of it and prolonged into the *Medulla spinalis*, with the Nerves that spring out of the same both within the Skull and in the Spine, all which we have considered as appendages to the Brain, seeing both the marrow out of which they arise, springs out of it, and also all the Nerves have their Animal Spirits from it. Next we come to speak of the smooth or unhairy part, called *Facies*, the Face.

Now though all the parts of the Body sufficiently shew the wisdom of the Creator; yet both

the beauty of the Face, and its admirable consent with the mind doth epitomise as it were the comeliness and dignity of all the other parts, and exhibits their affections as in a Glass. For from it are not onely taken signs of health, diseases, and imminent death; but also most clear tokens of the very disposition, manners and affections of the mind. For as shame and frightedness betray themselves in the *Cheeks*, so do anger, joy, sadness, hatred, and especially love, in the *Eyes*. So from the *Forehead* are known ones gravity and humility; from the *Eyebrows* (or *Supercilia*) pride; from the *Nose*, sagacity or blockishness; &c. from the *motion* of the Face, wisdom or foolishness, honesty or wickedness, civility or incivility, good-will or hatred; from its *colour*, the temperament of the whole Body. Besides, the sex, the age, the stock, and one Man from another may be distinguished by the Face.

The parts
of the
Face.

The parts of the Face are either containing, or contained.

The containing are proper, or common.

The common are sufficiently described in Book I. chap. 3. as not differing from the common integuments in other parts of the body. Onely here the *Membrana carnosæ* from the Eyes to the Chin is so thin that some have affirmed there is none: but in the Brows it is thicker and cleaves very close to the Skin.

The proper are the *Muscles*, *Bones* and *Cartilages*, which shall each be described in their proper places.

The parts contained are the Eyes, Ears, Mouth and Nose, and many besides, which shall be treated of in the following chapters of this Book.

The Face is divided into its upper and lower part.

part. The *upper* is from the Hair of the Skull to the Eyebrows; and is called *Frons* the Forehead, which while the Body is entire belongs to the Face, but in a Skeleton to the Skull. This is not to be treated of here, as consisting of no proper parts but *Muscles* and a *Bone*, which are to be described in their proper Books. The *lower* is extended from the Eyebrows to the Chin and includes all the parts betwixt them; and to the description of these we now proceed.

CHAP. XIX.

Of the Eyes in general, and their outward or containing parts.

THE Eyes (in Latin *Oculi*, from *occludo* to shut, or *occulto* to hide, because they lie hid under the Eye-lids) are the organs of sight, consisting of many similar parts; and are as the two Luminaries of the Microcosm, to afford us light; or like two Watchmen placed in the upper part of the Body as in a Watch-tower, to give notice of any approaching danger.

They are in *number* two, partly to make the sight stronger, and partly that one being hurt, the other might perform the function of seeing in some measure, though more imperfectly. *Their number,*

The Eye alone, divested of its Muscles, is of a *Figure* round or spherical *shape*, both that it might move the better in its orbit, and also that it might more conveniently receive the visible rays.

The *colour* of the Eyes in *Men* is sometimes *Colour*.

grey, sometimes brownish, sometimes black; which variety is most conspicuous about the *Pupilla* in the *Iris*, and proceeds from the colour of the *Uvea*. Brutes of the same species have not that diversity of colours.

Bigness.

Some have much larger Eyes than others; but those which are largest and stand much out, have not so acute and piercing a sight as those that are less and stand further in.

Consent.

There is great *consent* betwixt them, so that one being moved towards any object, the other is moved towards the same. The reason whereof we inquired before, chap. II.

Light.

Some think they have a kind of congenit or inbred *light*, without which they could not see; even as the Ears have a congenit Air within their cavities, without which they could not hear.

Situation.

They are each placed in a large Cavity, called *Orbita* (or a Socket) on each side the Nose, which is hollowed out of the bones of the Skull. And these orbits are invested on their inside with the *Pericranium*, to which the fat and origins of the Muscles cleave firmly. These may be reckoned the first *containing* parts of the Eye; as may also in the second place

The Eyelids.

The *Palpebræ* or *Eyelids*, which serve as Curtains to the Eyes, by which dust and troublesome smokes and vapours, too much light and the injuries of the air are kept out, and the outward tunic of the Eye called *Adnata*, but especially that called *Cornea*, which covereth the *Iris* and *pupilla*, is moisten'd, wip'd and clean'd. They consist outwardly of a very thin Skin which has no fat under it; inwardly they are lined with the *Pericranium*, that is here most thin and smooth.

Betwixt

Chap. XIX. Of the containing parts of the Eye. 409

Between these parts comes the *Membrana carnea*, which is also very thin. Each Eye has two. In Man the lower is less, and is but very obscurely moved in comparison with the upper: but in Birds the lower is the larger, and in most seems only to be moved, the upper remaining unmovable. At their edges they have little soft Cartilages, (called *Cilia* in Latine) to strengthen them, *Cilia*. and that they may meet the more exactly. Upon these Cartilages there grow Hairs, which having attained to a certain length, will naturally grow no longer, so that they never need to be cut. Those on the upper Eyelid turn something upwards, and those on the lower downwards. Above the upper Eyelid grow also a set of Hairs, between it and the Forehead, out of the *Supercilia* *Supercilia*. or Eyebrows; these lie pretty flat bending from within outwards, and hinder sweat, dust or other things from falling into the Eyes.

The Eyelids have two corners called *Canthi*. *Canthi*. The outer of these is less, and in its upper part it has a Gland placed (usually called *Innominata*, *Glands*. or nameless, but might be named *Lachrymalis*, as affording the most of that *Lympha* that makes the Tears.) This Gland is conglomerate, being made up of many lesser, and has small twigs of *Arteries* that creep to it and deposite *Serum* or *Whence Tears proceed*. *Lympha* in it to supply matter for Tears upon occasion. But the ordinary use of this *Lympha* is to moisten the inner side of the Eyelids and the superficies of the Eyes, that they may move more easily. *Steno* has observed that in a Calf the forepart of this gland is elegantly divided into Lobes (being indented on its edge) and that between the intervals of these there pass out excretory vessels from the gland, which running forward within the

the inner coat of the Eyelid make little holes in it at a little distance from the *cilia*, through which they discharge their humour. And he doubts not but there are such vessels in Men, in whom he calls them *vasa lachrymalia*. *Diemerbroeck* having reckoned eight opinions concerning the cause, origine and matter of tears rejects them all, and this we have mention'd with the rest : and thinks that their matter is the more serous and thin particles of the pituitous humour gathered in the Brain, and flowing to the Eyes upon its contraction, through the *Foramen lachrymale* seated at the inner corner of the Eye. Which the learned Reader may see defended in his *Anat. lib. 3. cap. 15*. There is another Gland in the inner *canthus* or corner seated upon the *foramen lachrymale*, which helps the former in its office. *Dr. Briggs* says, there are two or three lymphatick vessels, that receive *Lympha* from it, and end in the inner part of the Eyelid ; and that eight arise out of the former Gland and end in the *Tunica adnata*, where they continually deposite something of *Lympha*, to keep the Eye moist. *Nerves* come to them from the *fifth* pair, which communicating with the *Intercostal*, are much irritated in the passions of sudden joy or of sadness, and so twitch and compress these Glands that the *Lympha* is squeezed or milked as it were out of them, as *Dr. Willis* ingeniously supposes. *Steno* thinks, that in weeping, the flux of tears is principally owing to the contraction of the capillary veins, by which means the blood and *serum* cannot be so quickly carried back from these glands as they are brought to them by the Arteries, and therefore the *serum* ouzes out (as blood has also been observed to do sometimes.) Which opinion differs not much from

from Dr. Willis's, if we will suppose the contraction of the Veins to be owing to the Nerves, as it is reasonable we should.

As for the Muscles of the Eye, they shall be described in the fifth Book.

CHAP. XX.

Of the Tunicles of the Eye.

HAVING done with the outward or containing parts of the Eye, we come now to the Eye itself, and first of its Tunicles.

The outmost Tunicle of the Eye is common, and is called *Adnata*. It springs from the *Pericranium* and is spread over all the White of the Eye above the *Sclerotica*, reaching as far as the *Iris*. By this the Eye is kept firmly within its orbit, from whence it is also called *conjunctiva*. It is of very exquisite sense, and has many capillary Veins and Arteries creeping through it, which are most conspicuous in an Ophthalmia or inflammation of the Eyes. Under this Tunicle are the Tendons of the Muscles extended and expanded to the circumference of the *Iris*, which increase its whiteness; and some take them for a second Tunicle, calling it *Innominata*.

The tunicles of the Eye, one common;

The proper Tunicles of the Eye are three, according to the threefold substance of the optic Nerve. For this Nerve (as all the other) consists of two Tunicles springing from the *Dura* and *Pia mater*, and an inner marrowy substance. From the *Dura mater* springeth the outmost coat of the Nerve, and from this the Tunicle that is spread

Three proper. 1. Sclerotica.

spread next under the *Adnata*, called *Sclerotica* from its hardness; but in its forepart where it covereth the *Iris* and *Pupilla*, it is named *Cornea*, from its transparency; though sometimes this latter name includes the whole Tunicle, as well behind and on the sides as before.

2. Cho-
roides.

That which lieth next under the *Cornea* is much thinner than it, and is called *Choroïdes*, from its resembling the Membrane *Chorion* wherein the *Fœtus* is included in the Womb. Its fore-part is otherwise called *Uvea*, because it is somewhat of the colour of a Grape. This springs from the *Pia mater*, and is spread from the bottom or center of the Eye behind, all over the Eye to the *Pupilla*; to whose circumference when it is come, it becomes double, making with one part the *Iris*, with the other the *Ligamentum ciliare*. On the inside it is of a duskyish colour, (in Man) but blacker on the outside. But where it makes the *Iris*, it is of divers colours resembling the Rainbow, from whence it borrows its name: yet in some it is more blue, in others black, in others grey. This Tunicle is perforated before as wide as the *Pupilla* (or sight of the Eye) to permit the rays of visible species to pass in to the crystalline humour. Next unto which crystalline humour lies the *Ligamentum ciliare*, the second part of the duplicated *Uvea*. This consists of slender Filaments or Fibres, (like the Hairs of the Eyelids) running like so many black lines from the circumference of the *Uvea* to the sides of the crystalline humour, which they encompass, and widen or constrict as there is occasion, by contracting or opening the *Foramen* of the *Uvea*.

3. Reti-
formis.

The third Tunicle is made of the medullar substance of the optick Nerve, and is called *Retina*

or

Ch. XXI. Of the Humours and Vessels of the Eye. 413

or *Retiformis* (Net-like :) This seemeth to be the principal organ of sight. For as Dr. Briggs well argues, neither the crySTALLINE humour, through which the rayes pass much refracted ; nor the *Tunicle Choroides*, are at all fit for this use. For this latter part (as rising from the *Pia mater*) cannot communicate the impressions of the rayes to the medullar part of the Brain, which it does not at all touch. Whereas the medullar Fibres of the *Retina* have communication therewith, as springing therefrom, and therefore can well perform that office. The Fibres of this *Tunicle* are extended from the bottom or inner center of the Eye, where the optick Nerve enters it, as far as the *Ligamentum ciliare*, (to which it affords Animal spirits for the continuance of its motion.) If one take this *Tunica Retina* and put it into warm water, shaking it a little, to wash off the mucous substance that cleaves to it, and then hold it up to the light, these Filaments will appear very numerous like the threads of the finest Lawn.

CHAP. XXI.

Of the Humours and Vessels of the Eye,

NEXT to the Tunicles of the Eyes are the Humours contained in them to be considered. And these are in number three, viz. *Aqueus*, *Crystallinus*, and *Vitreus*. The second weighs as much again as the first, and yet not so much as the third by a sixth part, The Crystalline is the most dense of consistence by much ; and the glassy more dense than the watry.

The

1. Aqueous.

The *Aqueous* humour is outermost, being pellucid and of no colour (as neither are the other two.) It fills up that space that is betwixt the *Cornea* and the *Crystalline* humour before. If any thickish particles swim in it, then Gnats, Flies, Spiders webs and the like will seem to be flying before the Eyes. But if those particles grow still thicker, and close together so as to make a film, and this be spread before the hole of the *Pupilla*, then is the sight quite taken away, which disease is called a *Cataract*.

2. Crystalline.

The *Crystalline* humour (so called from its being as clearly transparent as Crystal) is placed betwixt the aqueous and the vitreous, but not exactly in the middle or center of the Eye, but rather towards its fore-part. It is inclosed in the bosom as it were of the vitreous humour, and is flattish on the fore-side, but rounder behind. It is more bright and solid than either of the other two. It has been the common opinion that it is inclosed in its proper Membrane, which is called either *Crystallina* from its transparency, or *Ara-neae* from its most fine contexture. But Dr. Briggs a very accurate Anatomizer of the Eye denies any such Tunicle, affirming that it is meerly adventitious when the humour is exposed for some while to the Air, or is gently boiled. As to the collection or reception of the rayes of things visible, this humour is the primary instrument of sight: though as was said before, the *Tunica retina* is the principal as to perception, because through it the rayes are communicated to the common sensory.

3. Vitreous.

The third and last humour of the Eye is the *Vitreous*, so called because it is like to molten glass. This is thicker than the Aqueous, but thinner

thinner than the Crystalline ; and much exceeds them both in quantity, for it fills up all the inner or hinder hemisphere of the globe of the Eye, and a pretty deal (toward the lateral superficies) of the formore. It is round behind, but hollowed in the middle forwards, to receive the Crystalline into its bosom. This humour is also said to be separated from the other two by a proper Tunicle, called *Vitreæ*, which the aforesaid ingenious Authour likewise denies.

See the situation of these Humours represented in Fig. 2. of *Tab. 14.* inserted p. 389.

The Eyes have *Arteries* from the *Carotides*, *The vessels of the Eye.* which bestow twigs on their Muscles, and on their Tunicles. And these are accompanied with *Veins* springing from the branches of the *Jugulars*. As for their *Nerves*, they either assist the sense of seeing, and are called the optic Nerves, which we have reckoned for the second pair and described before Chap. 10. or serve for the moving of them, being inserted into their Muscles, and to this purpose serve the third and fourth pair, and some twigs of the fifth. As to their *Lympheducts*, we have spoken of them above, Chap. 19. when we discoursed of the Glands placed at each *canthus* or corner of the Eye-lids.

The *action* of the Eyes is *Vision*. *The action of the Eyes.* Which is very well defined by *Diemerbroeck*. viz. That it is a sense, whereby, from the various motion of visible rays collected in the crystalline and vitreous humours, and darting upon the tunica retina, the colours of visible objects are perceived, with their site, distance, greatness, figure and number ;] the medium of which perception is the light. But we shall not enter upon a discourse of Vision here, as being more proper for a Philosopher than an Anatomist.

CHAP. XXII.

Of the Auricula.

The Ears.

AS the *Eyes* are placed in the upper part of the Body like two Watchmen to descry approaching danger ; so are the *Ears* there seated also, that they might give information of what the *Eyes* cannot discover either in the night for want of light , or through the interposition of some thick and opaque Body which the sight cannot penetrate. And as the *Eyes* contemplate the wonderfull works of God, whereby the mind may conceive of his Infinity ; so the *Ears* are the Inlets or Receivers of verbal instruction in all wisdom and science. For they are the organs of hearing, and are in number two, that the one failing, yet we might here with the other. They are placed in the Head, because sounds ascend.

Their
parts.
Auricula.

The parts of the Ear are either *outward* or *inward*. The *outward* is called *Auricula*, which is onely an adjuvant instrument of hearing, being spread like a Van to gather and receive the sounds.

The names
of its
parts.

Its upper part is called *Ala* or *pinna* the Wing ; and its lower and soft Lobe, usually *Infima auricula*. It has several protuberances or eminences, and cavities. Its outer protuberance that makes its circumference, from its winding is called *Helix* ; and that which is opposite to it, *Antihelix* : but that next the Temple, because in some it is hairy, is called *Hircus* or *Tragus* ; and that which is opposite to it, to which the soft lobe of the Ear is annexed, *Antitragus*, which likewise in some is

is hairy. Its *Cavities* are three. The inmost, because of the yellow Ear-wax (as we call it) that is gathered in it, is named *Alvearium*; as also *Meatus auditorius*; (of which more in the next chapter.) The next to this outwards which is bigger, from its tortuosity or winding is called *Concha*. The third is that betwixt the *Helix* and *Antihelix*, which has had no name imposed on it.

The constituent parts of the *Auricula* are either *Its constituent common* or *proper*. The *common* are *Cuticula*, *Cutis*, and *Fat* in the *Lobe*. The *proper* are the *Muscles*, *Veins*, *Arteries*, *Nerves*, the *Cartilage*, and a *Nervous membrane* or tegument which immediately embraces the whole cartilage, which some reckon to the *common* parts. As concerning the *Muscles*, they are set down in their proper treatise. The *Veins* come from the external *Jugulars*; the *Arteries* from the *Carotides*; the *Nerves* from the second pair of the Neck, being joined with the harder process of the seventh pair. As for the *Cartilage*, it is a substance that is fittest for this place. For if the Auricle had been bony, it might by many accidents have been broken off; or if it had been fleshy or onely membranous, it would not have stood so spreading, but have flapt down. Whereas a Cartilage is not in danger of breaking, and yet it is stiff enough to keep this outer part of the Ear expanded. It is tied to *Os petrosum* by a strong Ligament which riseth from the *Pericranium*.

The *uses* of the outward Ear or *Auricle* are *Uses*. these: First, it serveth for beauty. Secondly, it helps the receiving of the sounds. For first, it gathereth them being dispersed in the Air. Secondly, it doth moderate their *Impetus*, so that they come gently to the *Tympanum*. Such as
E c have

have it cut off upon any occasion, are very much prejudic'd in their hearing, which becomes confus'd with a certain murmur or swooning like the fall of waters.

Parotides. Both behind and below the Ears there are several Glands outwardly under the Skin, that are called *Parotides*. But there are two more notable than the rest, near one another; of which one is lesser, and is *conglobate*; but the other bigger, consisting as it were of many lesser, and is *conglomerate*. These serve to sustain the vessels that ascend this way, and are usually reckoned as Excretories of the Brain. From the *conglobate*, according to *Steno*, there arise Lympheducts, returning the *lympha* that is separated in them into the Jugular Veins; and in the conglomerate the *saliva* is separated, which is conveyed into the mouth by proper ducts: but of these more by and by in chap. 27.

C H A P. XXIII.

Of the inward part of the Ear.

Meatus
Auditori-
us.

THE inward part of the Ear is that which we properly call *Auris*, and begins at the *Meatus auditorius*, or that inmost cavity of the Auricle in which the Ear-wax is collected. This cavity ascends something with a winding duct, that the vehement *Impetus* of sounds may be a little infringed before they vibrate upon the *tympanum*. *Monf. du Verney* (that has lately writ a particular treatise of the Ear) says, that this *meatus*

or

or tube that reaches from the *concha* to the *tympanum*, consists partly of a cartilage, and partly of a bone. The skin that covers it, he says, is furnished with an infinite number of glandules of a yellowish colour, each of which hath its tube opening into this *meatus*, by which they send that yellow glewy substance which is ordinarily found in it, and hinders Insects from creeping into the Ear, entangling them like Bird-line. The Ear-wax.

Before its inner end is spread the *Tympanum* or Drum, which is a nervous, almost round and pellucid Membrane, of most exquisite sense, dividing the *outward* from the *inner* Ear. Some will have it to spring from the *Pericranium*, others from the *Pia mater*, a third sort from the *Dura mater*, a fourth from the softer process of the Auditory nerve expanded. And lastly, some think that it has a proper substance, springing from no other Membrane, but made in the first formation of the parts. It is very dry, that it might give the better sound. It is strong, that it should the better endure external harms. It is inclosed in a chanel or rift made in the circumference of the outer end of the bone that joins to the cartilage which forms the largest part of the *meatus*, and it hath a cord that runs cross it behind, which some take for a ligament to strengthen it, but *du Verney* says it is a branch of the seventh pair of Nerves, which supplies twigs to the Muscles that move the *tympanum*; (for it hath two Muscles to move it, which shall be described in the fifth Book, chap. 8.) The Tympanum.

When it is taken away, there appears a cavity on the inside of it, which by some is also called *Tympanum*, but by *du Verney*, the *Barrel*. Who says, it is a quarter of an inch long and half an inch The first cavity.

inch wide. It is encompassed round with bone, and clad within with a membrane that is interwoven with a great number of vessels.

Its four
little
bones.

In this cavity are contained *four* little Bones that are moveable, and conduce much to hearing. They have no marrow in them, nor are covered with any Membrane or *Periosteum*, yet at their extremities where they are joyned, they are bound with a small Ligament one to another. And they have this also peculiar to themselves, that they are as big in Infants as in grown persons, as are also the bones of the *Labyrinth* and *Cochlea*, according to *Veslingius* and *du Verney*.

1. Malleolus.

The *first* is called *Malleolus*, the little Hammer. It hath a round Head, which is inarticulated into the cavity of the Anvil by a loose Ligament. This Head is continued into a small Neck or handle, which reaching beyond the middle of the *Tympanum*, adhereth to it. About the middle it hath two processes: The one of which, being shorter but thicker, has the Tendon of the internal Muscle inserted into it; and the other being longer but smaller, the Tendon of the external, whereby this bone immediately, but mediately the *tympanum* is moved, as shall be further explained in the aforesaid chapter of the fifth book. And see Tab. 15. before going wherein all these four Bones with the Muscles are represented.

2. Incus.

The *second* is called *Incus*, the Anvil, having one Head, and two Feet, being somewhat like one of the grinding or double Teeth that has two roots, onely one of its feet is considerably longer than the other. The Head is pretty massie, having in the top of it a little smooth cavity, which receiveth the knob or head of the Hammer. The smallest (but longest) Foot is tied to the top or head

head of the Stirrop by a loose but firm Ligament; but the thickest, broadest and shortest resteth upon the *Os squamosum*.

The third is *Stapes*, or the Stirrop. This is not so compact and solid as the two former, but more porous. In figure it is almost triangular, in the middle hollow, to give way to the passing of the Air to the *Labyrinth*. In the upper part of it is a very small and round knob, upon which the longest foot of the Anvil resteth. Its shape is much adapted to the *Fenestra ovalis* (which opens into the Labyrinth) about which it is tied round somewhat loosely, so that it may be driven to within its *Sinus*, but cannot without violence be pulled outwards.

The fourth Bone was found out by *Franc. Sylvius*, and from its round shape is called *Orbiculare*. It is tied by a slender Ligament to the side of the *Stapes*, where the *Stapes* is joined to the *Incus*. *Du Verney* says, that this bone comes betwixt the long foot of the Anvil and the knob or head of the Stirrop: And that on that side next the head of the Stirrop it is convex, being received into a little cavity of the said head; and on that side next the foot of the Anvil it is a little hollow, receiving the said foot into it self.

From the lower side of this first inner cavity, wherein these bones are contained, there is a round *Meatus* or chanel to the Palate of the Mouth near the root of the *Uvula*; and another from its upper side that runs to the cavity of the Nostril, as has formerly been taught; but the aforesaid Author describing it to be much wider but a great deal shorter than the other, says, that it penetrates to within the sinuities of the mammillary process of the temple-bone. Those who thought

it to run to the nostrils, supposed it to convey thither pituitous matter collected within this first cavity ; but *du Verney* thinks its use to be, to permit the internal Air to retire into the sinuosities of the aforesaid process when the *tympanum* is driven inwards by the external Air, and that the internal air returns from thence again upon the relaxation of the *tympanum*. And as to the former chanel, he calls it an *Aqueduct*, and says that its first and shorter part is bony, but the second and longer partly cartilaginous and partly membranous, which part passing near the root of the Nose is lined with a glandulous skin that is a continuation of that which cloaths the inside of the Nostrils. So that he believes, that part of the air which is drawn in at the Nose penetrates this chanel (and so may ascend to the Ear) and on the contrary thinks that aqueous humours descend by it into the mouth by its aperture in the palate, for he denies that there is any valve in it which might stop any thing from passing either way. Other Authors (not denying this latter use, but not supposing that it had any communication with the nostrils ; instead of the former use derived from thence) have thought, that air and also sounds might pass through it in at the *Mouth* to the Ear, by observing that those who are thick of hearing do usually hold their mouths open when they listen attentively, which they do probably because they are partly assisted thereby in their hearing.

Two holes.

In the middle also of this cavity opposite to the *tympanum*, in the *os petrosum* there are two holes, the greater and higher of which is shut by the basis of the *Stapes* (when no sounds affect the Ear) and is of an oval figure, whence it is called *Fenestra*

Fenestra ovalis, and opens inwards or backwards pretty wide into the Labyrinth. The other is less and lower, and is of a round shape, whence it is called *Rotunda*. The orifice of this is open, but within the middle of its chanel it has a rift wherein is inclosed a thin, dry and transparent membrane like that of the *tympanum*. Behind which it is divided into two pipes divided by the *Ossiculum squamosum*, one of which tends to the *Cochlea*, the other to the Labyrinth.

This *Labyrinth* is the *second inner cavity*, being far less than the former, and was first so called by *Fallopins*, from the hollowed bony semicircles (cloathed with a thin membrane) returning circularly into the same cavity. The *Fenestra ovalis* and *rotunda* open into it out of the first cavity: and besides these holes it has five others, one of which opens into the end of the larger *Gyrus* or winding of the *Cochlea*: The other four are so small that they hardly admit an hair, through which the most slender Fibres of the auditory Nerve proceed to the inner membrane that encompasses this cavity.

The *third* and last *inner Cavity* is called *Cochlea*, because in its spiral winding it resembles a Snail's Shell. It is less than the Labyrinth, and has two, sometimes three or four spiral windings, which are cloathed inwardly with a most thin Membrane, into which, as into the Labyrinth, the slender Fibres of the auditory Nerve enter, through three or four very small holes.

Du Verney makes but two *inner cavities*, viz. the *Barrel* (which we described above) and the *Labyrinth*. But then he divides the Labyrinth into three parts: the foremost of which he calls the *Vestibulum* or Entrance; the second comprehends

the three semicircular conduits or chanel's, which (he says) are on that side of the Vestible which is towards the hinder part of the head; and the third is the *cocblea*, which is on the other side. But this new distinction is of less moment, and therefore I pass it over. As for the shape of the *Labyrinth* and *Cocblea*, it is shewn before in *Tab. 15*. But they are represented much larger than according to nature, as are also the bones in the first cavity, that their parts might appear more plainly.

The congenit Air. These three inner Cavities are all formed within the *Processus petrosus* of the Temple-bone, and in them is contained a most pure and subtle Air, which some think to be included in them in the very first formation of the parts, and therefore call it *Aer Instus* and *Congenitus*. Some suppose it to be Animal spirit, effused into them by the auditory Nerve.

The vessels of the Ear. This inner part of the Ear has *Veins*, *Arteries* and *Nerves* from the same origins as the outer: only the *harder* process of the auditory Nerve goes to the outer, and the *softer* to this inner, which coming by the hinder *Meatus* of the *Os petrosum* is inserted into and dispersed through the circles of the *Cocblea* and *Labyrinth*.

Hearing what, and how performed. All the parts of the *Auricula* and *Auris* concur to the perfecting the bearing, which is a *Sense* whereby sound is perceived from the various trembling motion of the external Air, beating upon the *Tympanum*, and thereby moving the internal Air with the *Fibres* of the auditory Nerve, and communicated to the common Sensory. Now sound that is the object of it, is nothing else but a quality arising from the Air or Water beat upon and broken by the sudden and vehement concussion of solid bodies.

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Chap. XXIV. *Of the Nose.*

425

And the diversity or greatness of such sound is distinguished by the four Bones that stand on the inside the *Tympanum* : For as from the greater or less, gentle or harsh impulses of the external sonorous Air (fluctuating like Waves caused by a Stone thrown into the Water) the membrane of the *Tympanum* is accordingly driven or shak't against the *Malleus*, the *Malleus* against the *Incus*, and the *Incus* against the *Stapes* ; so, as the same *Stapes* and *Os orbiculare* open the *Fenestra ovalis* more or less, is there a freer or straiter passage granted to the internal Air out of the first inner cavity into the Labyrinth and *Cochlea*, in whose tortuous and unequal windings it is variously inflected and modulated, from whence the *species* of sound that is made thereby, (according to the diversity of the external impellent) is sometimes more acute, sometimes more full, sometimes more harsh, sometimes more gentle, sometimes bigger, sometimes less : the *idea* of which *species* is carried to the common Sensory (and so represented to the mind) by the Auditory nerve that expands it self through the Membrane that invests the said Labyrinth and *Cochlea*.

CH A P. XXIV.

Of the Nose.

THE organs of *Seeing* and *Hearing* being *The Nose*. described in the foregoing Chapters, we come now to the instrument of the third Sense, *viz. Smelling*, which is *the Nose*.

The

Its external parts,
viz.

Skin.

Muscles.

Veins, Arteries and Nerves.

Bones.

Cartilages.

Its inner parts.

A glandulous membrane.

Hair.

The parts of the *Nose* may be distinguished into *external* and *internal*. The *external* parts are these, the *Cuticle* and *Skin*, *Muscles*, *Veins*, *Arteries*, *Nerves*, *Bones* and *Cartilages*. First, the *Skin* cleaveth so fast to the *Muscles* and *Cartilages*, that it cannot be severed without renting. Secondly, as for the *Muscles*, they are set down in the description of the *Muscles*, Book 5. Thirdly, the *Veins* come from the external *Jugulars*, as the *Arteries* from the *Carotides*. Fourthly the *Nerves* spring from the fifth pair. (*Steno* has observed in sheep and dogs a *Lymphatick* vessel in each nostril; and 'tis probable there are the same in men.) Fifthly, the *Bones* are described in Book 6. Chap. 6. Sixthly, the *Cartilages* are in number five; the two *upper* are broader, and adhere to the lower side of the *Bones* of the *Nose* where they are broader and rough, and being joyned to one another pass from thence to the tip of the *Nose*, making up one half of the *Ala*: the two *under* make up the other half, being joyned to the upper by a membranous ligament; the fifth divideth the *Nostrils*. These *Cartilages* are moved by the *Muscles*.

The *inner* parts of the *Nose* are These: First the *Membrane* which covereth its inside, which some think proceedeth from the *Dura mater*, passing through the holes of the *Os cribriforme* with the nervous fibres. This *Membrane* on its back side hath abundance of little *Papillæ* or *Glands*; in which the *Serum* or *Rheum* is separated that runs out by the *Nose*, (though *Diemerbroeck* thinks them to be the true organ of smelling.) Secondly, the *Hairs*, called in Latine *Vibrissi*, which hinder the entrance of *Insects* and of dust in a great measure, as one draws his breath in at his

his Nose. Thirdly, the red fleshy spongy substance, with which the holes of the *Os spongiosum* ^{Spongy flesh.} are filled up; from which the *Polypus* springeth.

The *length* of a comely Nose is the third part *Length.* of the length of the Face.

The upper part of the Nose which is bony, is ^{The deno-} called *Dorsum nasi*, or the ridge. The lower ^{mination} lateral parts, *Alæ* or *Pinnæ*. The tip of the Nose, ^{of its} *Globulus*, and *Orbiculus*. The middle cartilaginous ^{parts.} partition, *Septum*; and the fleshy part, that at the bottom of the *Septum* reaches from the tip of the Nose to the root of the upper Lip, *Columna*. The two holes that are caused by the partition, are called *Nares* the Nostrils. And these about their middle are each divided into two, one of which goes up to the *Os cribriforme*, to convey scents thither; the other descends down upon the Palate to the *Fauces*, by which Rheum falls down either of its own accord if it be very thin, or by snuffing the air up strongly in at ones Nose, if it be thick, which we may hawk and spit out at pleasure.

The Nose is an *external adjuvant* organ of smelling. ^{Its uses.} as the *Auricula* is of Hearing. For when smells exhale out of odoriferous bodies into the air, by taking our breath in at the Nose, the scents accompanying the air ascend up the Nostrils to the top of their Cavity, *viz.* to the *Os cribriforme*, through whose holes the olfactory Nerves (otherwise called *processus mammillares*) issue out by their Fibres, and are dispersed through the membrane that cloaths the inside of the Nostrils, especially its upper part: which Nerves, fibres and membrane are the *inward* immediate and *adequate* organ of Smelling. Other inferior

uses

uses the Nose has also ; as first, sometimes to take in our breath by, that we may not keep our Mouth always open for that purpose. Secondly, to help the Speech, which is very much impaired by the loss of it. Thirdly, it serves for the separation and discharge of the mucous humours in the Bloud.

CH A P. XXV.

Of the external parts of the Mouth.

THE next part to be described is the *Mouth*, whose parts are either *External* or *Internal*. The *External* are the *Cheeks* and *Lips*.

*The
Cheeks.*

*Their
glands.*

As to the *Cheeks*, their substance being Muscular, this is no proper place for their description (but Book 5.) onely we shall note from *Steno*, that betwixt their Muscles and the inner investing membrane of the mouth there is spread on each side towards the lower gums a large conglomerate *gland*, from whence many small ducts open into the cavity of the mouth, pouring *saliva* thereinto. And as to their *parts* we shall observe this further, that their upper part next under the Eyes, that jets out a little and is commonly highest of colour, is called *Malum* or *Pomum faciei*, in English commonly the Ball of the Cheek ; and their lower part that is stretched out in blowing of a Trumpet or the like, is called *Bucca*.

The Lips.

The *Lips* are framed of a carnos soft fungous substance, and of the Muscles, covered with a thin Skin. They are in number two, the upper and

and the lower. (Of their *Muscles* see Book 5.) The upper Lip has a little dimple in its middle which is called *Philtrum*; and its sides are named *Mustaches*, whence the hair that grows thereon is called *Mustaches*. The inside of the Lips is covered with a Membrane common to the Mouth and Stomach; from whence cometh the trembling of the lower Lip before vomiting.

The *uses* of the *Lips* are these: First, they help to retain the meat in the Mouth while it is chewing. Secondly, they serve for beautifying of the Face, if they be well fashioned. Thirdly, for the containing of the Spittle in the Mouth, that it should not drivel out constantly, but be spit out when we please. Fourthly, to keep the Gums and Teeth from external injuries. Fifthly, for framing of the Speech.

The uses of the Lips.

CH A P. XXVI.

Of the inner parts of the Mouth.

THE *inner* parts of the Mouth are these: The *Gums*, the *Teeth*, the *Palate* or *Roof* of the Mouth, the *Almonds*, the *Uvula*, the *Tongue*, the *Glands* and *salival ducts*.

The *Gums* (*Gingivæ*) are two, made up of a hard fleshy substance, destitute of motion, set like a Rampire about the Teeth for the keeping of them in their Sockets. 1. *Gums*.

As for the *Teeth*, look for them in Book 6. 2. *Teeth*.

Chap. 8.

The *Roof of the Mouth* is its upper part, some-
thing 3. *Palate*.

thing concave like a Vault, formed in the Os *sphenoides*, and serves partly for perfecting of the voice by repercussing the air, and partly assists the sense of Tasting. It consists of Bones (of which, Book 6. Chap. 6.) of a peculiar glandulous Flesh and a thick Tunicle, full of little holes for the *Saliva* that is separated in the Glands to destill through into the Mouth. *Steno* calls this glandulous flesh, the *palatine gland*, and says, it is conglomerate, and continued to the *tonsils*; and that there spring out of it innumerable slender ducts which perforating the membrane make it like a sieve.

4. *Almonds.*

Of the *Tonsillæ* or Almonds we have spoken before in Book 2. Chap. ult.

5. *Uvula.*

The *Uvula* is a red, spongie and longish Caruncle, that being somewhat broad at its basis hangs down from the middle of the Palate (where the Nostrils open into the Mouth) with a small but bluntish end. It is covered with a very lax and soft Skin, and is often swelled with defluxions of Rheum, hanging down flaggy, which is called the falling of the *Uvula*, and by ignorant people, the falling of the Roof of the Mouth.

6. *Tongue.*

The *Tongue* (*Lingua*, à *lingendo*, from *licking*) is the instrument of Taste and Speech. It is long and broad, thicker at the root than towards the tip.

Its membranes.

It is cloathed with two *Membranes*; The outer covers onely the upper part of the Tongue, and is very porous, being pretty smooth in Men, but in Brutes it is rough with abundance of copped bodies arising out of it, (and bending towards its root) like the Teeth of Wool-cards, of something a cartilaginous substance. This Membrane has a line that runs lengthways of it in its middle, dividing

viding the Tongue into two parts. The *inner* covers the whole Tongue, the lower side as well as the upper. This is thin and soft, and has many *Papillæ* protuberating out of it, which in the upper part of the tongue are inserted into the pores of the outer.

As to the *substance* of the Tongue there is great *Substance*. diversity of opinions. Some think it to be a Gland; others, that it has a peculiar substance; *Spigelius*, that it is truly a Muscle; and so does Dr. *Wharton* call it *verus Musculus*, though towards its root (he saith) it hath something of a glandulous substance. *Malpighius* (*exercit. Epistol. de lingua, p. 9.*) says it is rather musculous than glandulous, and describes its substance thus. "Immediately under the aforesaid Membranes there lie streight fleshy Fibræ, whereby the Tongue is drawn inwards and shortned. But the centre of the Tongue consists of a manifold kind of Fibræ, long, transverse and oblique, which riding one upon another are interwoven like a Mat.] But though this be its substance, yet it cannot properly be called a Muscle, both because no Muscle serves to move it self, but some other part; and also because one Muscle is not moved by another, as the Tongue is by several pair, to be described B. 5.

It is connected to the *Os hyoides*, *Larynx*, and *Fauces*, *Connexi-* and by a membranous Ligament to the parts *on*. under it. The extremity of which Ligament is called *Frænum*, which being too short, or extended to the tip of the Tongue, hindreth sucking in Children, when they are said to be Tongue-tied.

Its *Veins* proceed from the external *Jugulars*, *Vessels*. and are very apparent under the Tongue, where they are called *Ranulares*. The *Arteries* come from the *Carotides*. *Nerves* it hath from the fifth and eighth pairs.

The

*Actions
and uses.*

The *actions* and *uses* of the Tongue are these. First, it is the instrument of Tasting; especially the *Papillæ* in its inner Membrane, which have the extremities of the Nerves inserted into them. Secondly, it formeth or modulateth the Speech. Thirdly, it helpeth the chewing of meat, by tossing of it to and fro, and turns it down into the Gullet.

7. *Glands.*

Besides the *Glands* already mentioned there are several others, some of which are placed in the mouth, and others, though not seated therein, yet discharge into it by proper ducts that liquor that is separated in them, and therefore are properly enough to be treated of here.

*Paro-
tides.*

The first are the *Parotides*, whose true use *Steno* first found out. They are of two sorts, *Conglobate* and *Conglomerate*, and are both seated in the hollow under the Ear. The *Conglobate* are seated on the upper and fore side of the *Conglomerate*, and are of less consideration, serving only to separate the *lymphæ* from the arterial blood; and to conduct it by lympheducts into the Jugular Veins. But the *Conglomerate* are of a more notable use. They are of an irregular shape, such as the inequalities and eminences of the circumjacent parts grant to them. They have not only inserted into them Veins and Arteries from the external Jugulars and *Parotides*, and Nerves from the harder branch of the seventh pair; but also there springs out of each a peculiar vessel, commonly called a *salival duct* from the liquor it conveys. This vessel arises out of it by many small roots, that presently unite into one trunk, which running on the outside of the upper Jaw-bone as far as to the centre of the *Musculus buccinator*, there opens into the cavity of the mouth, into which

*Their sali-
val ducts.*

which it discharges the *saliva* which it had imbibed out of the *Parotis* of its own side. As to the origine and use of the *saliva*, we shall speak thereof by and by.

The next Glands are the *Maxillar*, which are *Maxilla-* either *External*, or *Internal*. The *External* are of less res. moment, being very small. They are seated outwardly about the middle of the lower Jaw, where the outer branch of the Carotid Artery, and the external Jugular Vein, with a remarkable branch of the fifth pair of Nerves ascend into the muscles of the face. It is probable these have no other use, but to separate *lymph*a and to convey it into the neighbouring Jugular Veins. The *Internal* are seated immediately within the lower Jaw. Their hinder side which is next to the *Parotides* and Jugular glands, is much thicker, and rounder, as also redder: but as they reach forwards, they wax thinner by degrees, and are extended betwixt the Jaw and the muscles of the tongue as far forward as to the chin, as Dr. *Wharton* affirms. They are conglomerate, and have each a proper vessel (first found out by the said Author) arising out of them as the conglomerate *Parotides* had: which vessels are called the *inner salival ducts*, as those springing from the *Parotides*, the *outer*; these running on the inside of the lower Jaw, as those did on the outside of the upper. These vessels spring by many small roots out of the thicker and hinder part of the glands, and run streight forwards towards the chin, but in their passage each trunk does here and there receive new twigs springing out of the gland. When they are come to the middle of the chin, they end there just within the gums, and have each a certain pa-

pilla affixed to their orifice, whereby they can easily discharge themselves, and yet nothing return out of the mouth into them.

Sublinguals.

The last Glands to be treated of are the *Sublinguals*, which *Steno* thus describes. They are seated on each side by the sides of the tongue, and are of the same kind with those of the cheeks, differing not therefrom but that their excretory vessels are narrower. Which vessels run parallel to one another from the tongue towards the gums, penetrating the investing coat of the mouth at a little distance from the gums with small orifices, which can hardly be discerned without pressing.

The use of the glands and saliva.

Now the use of all these Glands is to separate the *saliva*, and to convey it into the mouth by the salival ducts. As to the origine of the *saliva*, it is most probably derived from the Arterial blood. For as the Arteries pour nutritious blood into all other parts, so they do into the glands also; part of which they convert into their own nourishment, and part (*viz.* what is serous) they separate, and bestowing a subacid quality thereupon make *saliva* (or spittle) of it, which perhaps is also impregnated with some nervous juice, seeing these glands have all of them nervous twigs inserted into them. Now the *saliva* is not to be reputed a meer excrement, for it is believed by all Anatomists, that it serves for the furthering of the fermentation of Meats in the Stomach, if it be not the main ferment of it. That it has a fermentative quality *Diemerbroeck* proves by this experiment, That if a piece of white Bread be chewed and moisten'd with much Spittle, and then be mixed with Wheat-paste kneaded with warm Water,

ter, it will make it ferment. But how far it contributes to the fermentation of meats in the Stomach, or to chylification, was shewn above in the first Book chap. 7. where we discoursed of the *Stomach*, and therefore we shall speak no more of it here.

The end of the Third Book.

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it is will make it lament. But how far it con-
tributes to the formation of men in the sto-
mach, or to civilization, was shown above
in the first Book chap. 7. where we discussed
of the disease, and therefore we shall speak no
more of it here.

The end of the Third Book

112

The Fourth Book.

CONTAINING

A Description of the **VEINS**, **ARTERIES** and **NERVES**

OF THE

LIMBS.

CHAP. I.

Of the Veins of the Arms.

IN the three former Books we have finished the description of the three Cavities or Ventricles of the Body; out of which those *Vessels* arising that are propagated to the *Limbs*, it seems convenient to subjoin thereunto a short treatise of the course that those Vessels keep in these parts.

In Book 2. Chap. 9. treating of the Ascending trunk of the *Vena cava* we shewed, that when it arrived at the top of the *Thorax* it was divided into two branches called *Rami subclavii*; which,

running obliquely under the *Clavicula*, as soon as they were past them and come to the Arm-pit, were called *Axillares*. Now each of these parteth it self into two Veins, the *Cephalica*, and *Basilica*. But before their division they send forth two small Veins, viz. *Scapularis interna* and *externa*; whereof the first passeth to the Muscles that lie in the cavity or inside of the *Scapula*, the latter to those on the outside.

Cephalica.

The *Cephalica* passeth through the upper or outward part of the Arm, to the bending of the Elbow, where it is divided into two branches; of the which one, joining with the *Basilica*, makes the *Mediana*, which is very frequently opened when one is let blood in the Arm: The other, marching along the *Radius*, reacheth to the Hand, through which it is spread; but chiefly in that part which is between the Ring-finger and the little Finger, where it is called *Salvatella*.

Basilica.

The *Basilica* passeth through the inner and lower part of the Arm, accompanied with the Artery and Nerves.

About its beginning there spring out of it the *Thoracica superior* and *inferior*, (though sometimes these arise from the Axillar before its division) of which the former runs to the inside of the pectoral Muscle, &c. the latter to the *Musculus latissimus* of the Back, and all over the side of the *Thorax*, where tis said to inoculate with the twigs of *Vena sine pari*.

Its branches.

Basilica about the bending of the Elbow is divided into two; one of which is called *Subcutanea*, running just under the Skin; and the other *Profunda*, because it lies hid deep in the flesh.

Subcutanea.

The *Subcutanea*, or shallowest branch, near its origine turns up to the outer part of the *Ulna*, and

Chap. II. Of the Arteries of the Arm.

439

and is carried along it to the Hand.

The *profunda* descends between the *ulna* and *radius*, (but towards the wrist is carried by the outer part of the *ulna*) to the hand also.

The *Mediana* is also double, *profunda* and *superficial*. The *Mediana* ; both which run by many twigs through the Muscles of the Cubit to the Hand and Fingers.

Note, that since the circulation of the Blood has been generally believed, it is held indifferent which of these three Veins (the *Cephalica*, *Basilica* or *Mediana*) are open'd in blood-letting; for they all receive their Blood from one common Artery, viz. the Axillar, which returns by them all indifferently towards the Heart: onely it is best to open that which is fairest.

CHAP. II.

Of the Arteries of the Arm.

As soon as the *subclavian* branches of the ascending trunk of the *Aorta* are past out of the *Thorax*, they are called *Axillar*, (like the Veins) as we shewed in Book 2. Chap. 11.

This Artery before it arrive at the Arm sendeth out of its upper part *Humeraria*, which is bestowed on the Muscles of the Shoulder: and out of its lower, *Thoracica superior*, *inferior*, and *Scapularis*, which run to the same parts with the Veins of the like denomination in the foregoing Chapter. Then having communicated small twigs to the Glands in the Arm-pit, it accompanieth

the *Basilica* along the Arm; (for there is no Cephalick Artery.) When it is come to the bending of the Elbow, it is parted into two branches, which pass almost wholly to the inner side of the hand; for the backside hath no Artery but from a small twig that runs betwixt it and the bone of the Thumb.

The one of these resting upon the *Radius*, is that which beats about the Wrist, and is commonly felt by Physicians.

The other marcheth by the *Ulna*, and with the former is spread through the Hand.

CHAP. III.

Of the Nerves of the Arm.

THE Nerves that spring from betwixt the three lowest *vertebrae* of the Neck, and the first three of the Back do every one send a branch towards the Arm; all which for their greater strength uniting with one another, and again separating are carried under the *Clavicula* to the Arm-pit, where they are interwoven together like a Net; but they pass out of it again separate one from another. The first of them that springs from the fifth pair of the Neck goes to the Muscle *Deltoides*, to the second Muscle of *Oxyoides*, and to the Skin of the Arm. All the other five are bestowed wholly on the Muscles and Skin of the Arm and Hand.

CHAR

C H A P. IV.

Of the Veins of the Thigh, Leg and Foot.

THE Iliacal branches of the *Vena cava* after they are descended as far as the Thigh (where we left them B. 1. Ch. 13.) are called *Cruales*, which being past the Groins are each divided into six more notable Veins, viz. *Saphæna*, *Ischias major* and *minor*, *Muscula*, *Poplitea* and *Suralis*. The first called *Saphæna* descends down on the inside of the Thigh and Leg betwixt the Skin and *Membrana carnosæ*, and appears pretty large on the inside of the Ankle, where it is frequently opened in Diseases of the Womb, and may with great safety, having neither Artery nor Nerve accompanying of it. The *Ischias major* is that which runs down on the outside of the Ankle (where it is wont to be opened in the *Sciatica*, or other distempers of the Hips;) but the *minor* goes no further than the Muscles of the Hip. The other three are spent on the Muscles, Skin, &c. of the Thigh, Leg and Foot.

C H A P. V.

Of the Arteries of the Thigh, Leg and Foot.

IN B. 2. Ch. 11. describing the descending branches of the *Aorta*, we traced them to the Thighs,

Thighs, where the *Rami iliaci* begin to be called *Crurales*, as was said of the Veins. The Crural artery is less than the Vein, and before it arrive at the Ham sendeth forth three branches, viz. *Muscula cruralis exterior*, *interior*, and *Poplitea*. The first enters the fore Muscles, the second the inner Muscles of the Thigh; and the third runs down the hinder Muscles as low as the Ham, whence it has its name. When the trunk of the Crural artery is past the Ham, it sends out three more called *Tibiaa exterior*, *posterior elatior* and *posterior humilior*, which are bestowed on the Muscles, Skin, &c. of the Leg and Foot; and what remains of it descends to the Foot, upon which it is spent.

C H A P. VI.

Of the Nerves of the Thigh, Leg and Foot.

THE three lower pair of Nerves of the *vertebra* of the Loins, and the four uppermost of *Os sacrum* constitute the Crural nerves. For all these very near their rise joining together, and proceeding united for a while, make four Nerves. The *first* and *third* enter the Muscles that lie upon the Thigh-bone whether for *its* motion, or of the Leg. The *second* accompanies the Crural Vein and Artery down by the Groins and the inside of the Thigh, on whose formore Muscles it is most of it spent, but sends one notable branch down the Leg, as far as to the great Toe. The *fourth* is the thickest, hardest, and strongest of all the

the Nerves in the Body. This distributeth twigs to the Skin of the Buttocks and Thigh, to the Muscles of the Thigh and Leg, and being descended to the Ham is divided into the outer and inner branches, which bestow twigs on all the Muscles and Skin of the Leg and Foot, to which there comes no other Nerve, but the forefaid branch of the *second*.

The end of the Fourth Book.

The Fifth Book.

CONTAINING

A Treatise of all the
MUSCLES
Of the BODY.

CHAP. I.

Of a Muscle in general, and of its parts.

A Muscle in Greek is called *mys* a mouse, (of *A Muscle.*
which *Musculus* in Latine is but a dimi- *Its name.*
nutive) either because it resembles a fle'y'd
mouse; or else from *mys* to *contract*, which is its
action. And under this denomination is under-
stood all that which is properly called flesh; which
is not one continued substance through the whole
body, but consists of divers parts or parcels, that
have no continuation of substance, but lie onely
contiguous to one another in such convenient and
decent order and situation, as may conduce to
the comeliness of the body, and the performance
of each one's particular office.

Now

Definiti-
on.

Now a Muscle is rightly defined to be a *diffimilar or organical part*, (framed of its proper membrane, a fibrous flesh, a Tendon, Vein, Artery, and Nerve) *appointed by nature to be the instrument of free motion.*

Constitu-
tive parts,
viz. com-
mon and
proper.
The com-
mon are
Arteries,
Veins, and
Nerves.

By which definition seeing it appears to be a dissimilar part, consisting of many similar, we shall in the first place examine what these are.

They are either *common or proper*. The *common* are three: The Vein, the Artery, and the Nerve. The *proper* as many, viz. the fibrous flesh, the Membrane, and the Tendon.

The *Arteries* bestow on the Muscles, (as on all the other parts of the Body) Vital heat and nourishment; the *Veins* carry back from them what blood is not assimilated to them; and the *Nerves* bring Animal spirit whereby their action is performed. And these Nerves spring either from the *medulla oblongata* within the brain; or from the *spinalis*, so called after it is descended out of the skull into the spine. The Nerve is implanted either into one end, or about the middle of the Muscle; but at what part soever it is inserted, that is reputed the head of the Muscle. As soon as it hath entered into the substance of the Muscle, it is divided into innumerable twigs, which in a little space from its insertion become so very slender and fine, that they escape the sight.

Why called
common.

Now these are called the *common* parts of Muscles, because they are common to them with other parts of the body that are endowed with the same kind of vessels. But as to each particular muscle, they have every one their peculiar and proper vessels, numerically distinct. That is, though those twigs of Vessels that are inserted into one Muscle,

Muscle, be propagated from the same trunks from which other twigs pass to other Muscles; yet those twigs, whether of Arteries, Veins or Nerves, that are bestowed on one Muscle, are wholly spent thereon, and pass not out through its investing membrane again to any other.

The proper parts are so called, because they are proper and peculiar to a Muscle, and not common to any other part. The proper why so called.

The first of these is *fibrous flesh*, which some distinguish into two parts, *fibres* and *flesh*. These are 1. Fibrous flesh.

A fibre is thus defined by Dr. Glisson in cap. 4. de Ventric. *A body in figure like a thread, slender, tenacious, tensile, and irritable, made of spermatical matter, for the sake of some motion and strength.*

Which he thus explains: "In figure like a thread"]

"i. e. oblong and round; slender] like a spiders

"web: tenacious] whose parts firmly cohere and

"are not easily broken; tensile] viz. that may be

"extended as to longitude, its latitude being less

"and in like manner that may be thickened

"as to latitude, its longitude being shortened; ir-

"ritable] i. e. which by irritation may be excited

"to contract it self, and the irritation ceasing, to

"be remitted of its own accord; made of spermat-

"ick matter] namely if it be a bare Fibre; but if

"it be stuf with a *parenchyma*, perhaps it is not

"always made of onely spermatick matter; (for

"the stuf Fibres may be divided into sanguine-

"ous and spermatick; of the former kind are those

"of the Muscles; of the latter, those of the sto-

"mach and guts :) for the sake of some motion and

"strength] for in that it is tenacious it adds strength

"to the part, and that which is apt to be exten-

"ded and contracted is destin'd for some motion.]

The fibres are commonly *straight*, wherefore

Their those cons.

those Muscles that are called *oblique* and *transverse* have not their names from the course of their fibres, but from their own position and situation in respect to the body. Yet they are not *always* streight, for sometimes they pass a little curved or crooked towards their tendon, as in the Muscles of the Temples; sometimes they run round, as in the sphincters. But very seldom (if ever) has any Muscle double fibres; wherefore the Muscle *Masseter* is accounted double, because it hath two sorts or ranks of fibres, one lying upon and crossing the other.

*Flesh
what, and
of what
made.*

These Fibres being stuff in their interstices with a sanguineous *parenchyma*, are that which we properly call *flesh*. For (saith Dr. Croone) all the flesh of a Muscle (which makes the greatest part of it, and of which the bulk of the whole body chiefly consists) seems to be nothing else but that portion of the blood that flows through the intervals of the Fibres, which thickning by their coldness is staid amongst them.] In some Muscles in fat people the (lean) flesh is interlarded with some fat: but that fat is not a necessary part of a Muscle, seeing it is not in all Muscles even in fat persons; and in very lean, in none.

2. *AMem-
brane.*

Every Muscle hath a proper *membrane* that invests it, and distinguishes it from others. Now some reckon the membrane for a *common* part, because Membranes invest other parts besides the Muscles, as for instance the Bones: but if we consider that the muscular membrane is of a peculiar sort, framed out of the fibres expanding themselves at their ends, we may with reason enough esteem it a *proper* part. I say the membrane is made out of the fibres expanding themselves at their ends: to conceive which we must understand that

that the fibres run not lengthways of the Muscle, so as to reach from one end of it to the other; but from one side of it to another, yet not directly, but a little sloping. Notwithstanding they are streight in figure, if you consider them apart, and run parallel one by the side of another. The membrane that is composed of them is spread over all the parts of the muscle, even unto the end of the Tendon in such Muscles as have one.

The last proper part of a Muscle is the Tendon, which *Spigelius* defines thus: *It is a similar and simple part, of a peculiar kind, diffused through the whole body of the Muscle lengthways, which in some part thereof is united (and there it is white with a kind of brightness, dense, hard and smooth) and in some divided and stuffed with flesh (where it is not easily discernible:) and seeing it is very much adapted for contraction, when it is contracted at our pleasure, it moves together with it self that part into which it is inserted.*

3. A Tendon.
Its definition.

All Muscles which are appointed for the moving of bones, have Tendons which are inserted into those bones they are to move: but commonly those which move other parts, as the Tongue, Lips, &c. as also the Sphincter of the Bladder, and anus, have none, or however such as are not easily discoverable; for indeed some affirm (as *Dr. Crgone*) that every Muscle has its Tendon.

Which muscles have tendons.

There are sundry opinions as to the substance of a Tendon. *Spigelius* (as appears by the foregoing definition) thinks it to be a simple part, that is, truly similar, and not appearing so to the eye onely. He says it is neither a Nerve, nor a Ligament, nor is a substance mixt of both; but it is a part of its own proper kind, softer than a

Of what they are framed.

G g

Ligament

Ligament and harder than a Nerve. *Vesalius* on the other hand affirms (with *Galen*) that it is a dissimilar body, composed of a concurrence of fibres, ligaments and very slender Nerves, growing by degrees into one body. *Diemerbroeck* doubts not but that the Nerve which enters into any Muscle, is extended as far as its tendon (though it cannot be traced by the eye thither) because of the very acute sense of the tendon; and yet the tendon, he says, is not a mere Nerve, but 'tis likely that the fibres and membrane with a ligament are intermixed with it.] I think 'tis most probable, that it is onely a production or prolongation of the fibres freed from their *parenchyma*, and cloathed with the investing membrane of the Muscle, which it self is also derived from the fibres, as was noted above. But whatever its substance be determin'd to be, it is the principal part of the Muscle, and the chief instrument of its action.

Their figure.

The Tendons are sometimes round, as in the *musculus biceps*; sometimes broad, as in the oblique and transverse Muscles of the Belly.

The parts distinguished from the position.

These are the *parts constitutive* of a Muscle. It hath besides these, parts derived from the *Position*, (or rather from its *use*) and those are three: The Head, the Tail and the Belly. The Head or beginning is that part of the Muscle that arises from the part unto which the contraction is made: the Tail or end is that part of it which is inserted into the part which is moved: the Belly is all that (fleshy) part that lies betwixt the Head and Tail.

The use of a muscle.

The *use* (or rather *action*) of a Muscle was intimated in the last part of the definition, in that it was said to be the instrument of *free* motion; which word we rather make use of than of *voluntary*,

lunary, because beasts have Muscles and motion, unto whom *will* properly so called is denied, because it presupposeth reason. But hereof more in the next chapter.

CHAP. II.

Of the differences and actions of the Muscles.

THE differences of Muscles are taken from *The differences of muscles.*
fundry things: First, from their substance: so some are fleshy, as most of the Tongue and larynx: some are membranous, as the *constrictores* or internal *adductors* of the nose: and some are partly fleshy, and partly nervous, as the temporal.

Secondly, from their quantity: whence some are long, as the straight Muscles of the abdomen, the longest of the back, &c. others short, as the pyramidal at the bottom of the abdomen: some broad, others narrow; some thick, others thin and slender, &c.

Thirdly, from their situation: from hence some are called *external*, some *internal*; some *oblique*, some *straight*, some *transverse*.

Fourthly, from their figure: as *Deltoides*, because it resemblerh the Greek letter Δ *delta*; some round, others square, &c.

Fifthly, from their beginning: so some proceed from bones, one or more; some from cartilages or gristles, as those of the larynx; and some from the membrane that invests the tendon of some other Muscle, as the *Lumbricales* of the hands and feet.

Sixthly, from their *insertion*: some being inserted into *bones*, as most are; some into *cartilages*, as the Muscles of the Eye-lids, &c. others into a *membrane*, as those of the Eye, &c.

Seventhly, from their *composition* or *variety of parts*; so some are called *bicipites* and *tricipites*, having two or three heads; others *bi ventres*, having two bellies.

Eighthly, from their *action*: from whence four differences of Muscles are taken: for *first*, some are hence called *fraterni* or *congeneres*, brotherly, because they assist one another in their action; some *antagonistæ*, adversaries, because they have an opposite motion. *Secondly*, some onely move themselves, as the sphincters; some other parts, as the rest. *Thirdly*, some have one onely action, as the greatest part of the Muscles; some have divers actions, as the *masseter* and *trapezius*. The *fourth* difference is taken from the variety of the action; so some are called *flexores*, others *extensores*; some *elevatores*, others *depressores*; some *aductores*, others, *abductores*. Others *suspensores*, *rotatores*, &c.

Thus much of the *differences* of Muscles one from another: in the next place proceed we to their *Action*, in which they all agree.

Their
action.

Now the proper *Action* of a Muscle is the *contraction* of it self, whereby it brings the part from which it arises and that into which it is inserted, nearer to one another.

The efficient
cause,
and mediate
instrument
thereof.

The *Efficient cause* of this Action is the Soul or the Loco-motive, Animal faculty, which being invited, or offended by some object, moves the whole body, or some member of it, in pursuance or avoidance thereof; of which motion the Muscle

is the *immediate* instrument, but the Nerves conveying the Animal spirits to the Muscle, are the *mediate*.

I said even now that the *proper* action of a muscle is contraction, but that is not the onely motion it is capable of, for Anatomists commonly ascribe to it four different motions: The *first* is that already mentioned, *viz.* contraction; the *second* is the perseverance of the contraction: the *third*, the relaxation of the contraction; and the *fourth*, the perseverance of the relaxation. The perseverance is called *motus tonicus*, whereas the member is still kept in the same posture.

These four motions are common to every particular Muscle; but there are others which agree some to one, some to another, in respect of their situation: So a streight Muscle hath a streight motion; a transverse, a transverse motion; an oblique, an oblique; and a sphincter, an orbicular.

As for the *reason* and *manner* of motion, whereof different Authors have invented various *hypotheses*; as it would be too large a task to examine these, so I think it too *difficult* to explain those. And therefore waving all such speculative and conjectural discourses, I proceed to the description of the Muscles themselves, wherein I may appeal to the Hand and Eye of any skillfull dissector.

C H A P. III.

Of the Muscles of the Eye-lids and Fore-head.

The muscles of the Eye-lids, viz. Recti,

THE Upper Eye-lids are moved very manifestly, the lower more obscurely; wherefore the upper have each a Muscle that the lower want, which is called *rectus* or *aperiens*, serving to pull it up. It is placed in the upper region of the orbit of the Eye, and springeth from the same origine with the *elevator* of the Eye, (above it) namely at the hole through which the optick Nerve passes into the orbit, and holds the same course with it, being of the same figure and substance, viz. fleshy, till at last parting from it, with a pretty broad but thin Tendon it is inserted into the cartilage of the upper Eyelid, which it serves to lift up, and so to open the Eye.

These I say, are proper to the upper Eyelids; but the following belong to the lower as well as upper.

and Semicirculares.

They are called *Claudentes*, or shutters of the Eyelids, as also *semicirculares*; (others call them *circulares* taking them for one.) They are placed between the *membrana carnosæ* and the inner Membrane of the Eye-lids that is extended from the *pericranium*. That which draweth down or shutteth the upper, is the larger, and ariseth from the inner corner of the Eye and that part of the *supercilium* that is next to the Nose, with a sharp beginning: from whence it passes transversely toward the outward corner, growing presently fleshy and broader, so that it filleth up all the space betwixt the Eyebrow and the lowest edge of

of the Eyelid on which the hairs grow, (which is called *cilium* or *tarsus*) and at length is inserted into the outer corner. That which moveth the lower (though but obscurely) in order to shut it, is less, being membranous and thin, arising from the side of the Nose with a sharp beginning as the other; whence being carried transversely it comes to the middle of the Eyelid, where becoming something fleshy it continues its course to the outer corner which it turns about, and ascending to the upper Eyelid is inserted into it with a broad end. These two Muscles being contracted shut the Eye, the greater drawing down the upper Eyelid, and the less pulling up the lower. But the lower has no Muscle to pull it down again, seeing its own gravity and the relaxation of its fibres is sufficient for that purpose: whereas the upper, as was observed before, has a peculiar Muscle to pull it up.

Yea besides the *Recti* aforesaid, there sometimes The Frontales. concur, when we would open our eyes very wide, the *musculi frontales*, or Muscles of the forehead, which spring from the Skull near the coronal suture, and having their outer edge knit to the temporal muscles, are contiguous to one another with their other side upon the middle of the forehead, upon which they descend with straight Fibres to the Eyebrows, where they terminate. By the help of these we draw up and wrinkle the forehead, and by consequence pull up the upper Eyelid a little. The skin grows very close to these Muscles.

Some describe another pair of Muscles of the Corrugantes. Forehead, called *Corrugantes*, whose fibres descending aslant from the lower part of the *Frons* betwixt the Eyebrows towards the top of the Nose,

where they meet one another) help to knit the brows (as we call it) when we frown. But these seem to be onely a part of the frontal Muscles, having their fibres running in this place a little obliquely.

CHAP. IV.

Of the Muscles of the Eyes.

Each Eye
hath six
muscles.

THE Muscles of each Eye are in number six; four *streight*, and two *oblique*. The *streight* move the Eyes upwards and downwards, to the right hand and to the left: the *oblique* move them obliquely. The *streight* are more thick and fleshy than the *oblique*.

Four
streight.

Their rise
and inser-
tion.

As to their beginning, (*viz.* of the *streight*) they have all the same origine; as to their progress, the same structure; and as to their end, the same insertion. Their *origine* is contiguous and acute, being at the hole through which the optick Nerve enters the orbit of the Eye, from whose Membrane they spring. Their *middle*, or belly, is fleshy and almost round. Their *end* is a most thin and membranous Tendon, whereby they are inserted into the *tunica cornea*, where it is pellucid, near the *Iris*, and so do encompass the whole Eye before as far as it is white.

The *first* of the *streight* is called *attollens* or *Elevator*, because it moveth the Eye upwards; and it is somewhat larger than the second that moveth the same downwards, because it requireth greater force to pull any thing upwards than downwards.

wards. This first is otherwise called *superbus*, because that motion of the Eye is owing to it, when we are said to look high. For which reason the second has the name of *humilis*, because by it we look down; whence also it is otherwise named *deprimens*. The third is called *adducens*, because it moveth the Eye inwards towards the Nose; as also *bibitorius*, because we are wont to use it to look into the glass or cup when we drink. The fourth is called *abducens*, from its drawing the Eye outwards from the inner corner to the outer; and also *indignatorius*, because that motion or cast of the Eye (as we call it) is proper to men in the passion of anger.

The first is placed in the upper region of the orbit, the second in the lower, (opposite to the upper) the third in the inner corner of the Eye, the fourth in the outer.

The oblique Muscles are called *circumagentes*, Two oblique. winders or rollers about, and *amatorii*, or amorous; and are in number two. The first is *obliquus major*, or *superior*, the upper and larger. Their rise and insertion. This beginneth at the hole by which the Optick Nerve enters into the orbit of the Eye, as the four foregoing pair did, and passing to the upper part of the inner corner of the Eye, endeth in a small and round Tendon, which passeth through a transverse cartilage there placed, (called by *Fallopins trochlea*) as a cord through a pulley, and is inserted into the upper side of the *cornea*, betwixt the *attollens* and *abducens*. This seems to be a very considerable Muscle, seeing the fourth pair of Nerves (called *Nervi paralytici*) are wholly spent upon it, according to Dr. *Willis*. The second is *obliquus minor*, or *inferior*, the lower and smaller. This springeth from the lower and almost outer part

part of the orbit, (namely at the juncture of the first bone of the upper jaw with the fourth) with a carnous beginning. It is slender but not quite round, and passeth obliquely to the outer corner of the eye, which having turned about, it ends in a short, roundish and nervous Tendon, which meeteth with the Tendon of the other oblique Muscle, and is inserted obliquely near the Iris betwixt the Tendons of the *attollens* and *abducens*, with the other, so that both seem to have but one Tendon. This rolleth the Eye towards the Nose, as the other draweth it from it.

How these
muscles
are to be
shewed.

Before you shew the Muscles of the Eye, cut off the fat with your scissers, then shew first the *obliquus major*, then the *obliquus minor*, and last of all the four streight Muscles. Nevertheless let the *obliquus major* remain last, when all the rest are taken away, that you may shew how the Tendon of it passeth through the *trochlea* or pully the more plainly.

Trochlea. Which *trochlea* is thus described by *Spigelius*: It is a little round cartilage, hollowed like a pipe or piece of a straw, that is suspended by a Ligament in the inner corner of the eye, through which the tendon of the greater oblique Muscle passing, procures unto that Muscle the name of *Trochlearis*.

CHAP. V.

Of the Muscles of the Nose.

THE Nose is not all of it moveable, but only its lower griffly parts, which are called *Ala* or *Pinnae*. And these are either drawn together to shut the Nostrils, which is performed by the *adducent* Muscles; or drawn asunder to open the Nostrils, which is done by the *abducent*. And there are two Pair to serve each Office.

Before I enter upon the description whereof, I desire it may be noted, (once for all) that though all the Muscles of the body be double (except the Sphincters) so that they are commonly reckoned by Pairs; yet in their description we shall speak of them in the singular number, as if there were but one of a sort. Which method (after this advertisement) can occasion no mistake or inconvenience, seeing all the particulars that agree to one, agree to its fellow likewise.

The first of the *abducent* or opening Muscles is small, rather Carnous than Membranous, arising from the upper Jaw-bone, near the first proper Muscle of the Lips, and is inserted partly into the lower part of the *ala* of the Nose, and partly into the upper part of the upper Lip, by the dimple in its middle which is called *Philtrum*. The second covering the side of the Nose, begins at its top near the *foramen lachrymale*, with an acute and fleshy Origine, and descending obliquely by the bone of the Nose it ends in a broad Basis, and still remaining fleshy is implanted into the *Ala*. It is near of a three-square or triangular shape, like the

the Greek Letter Δ *delta*, whence it is called by some *deltoides*. These two by drawing the *Ala* upward widen and open the Nostril.

Two adducent.

The *adducent* or closing Muscles are very small ones, so that they can hardly be discovered or distinguish'd exactly but in them that have large Noses. The *first* of these is *external* and fleshy, rising about the root of the *Ala*, which it ascends, creeping transversly over it to the ridge or tip of the Nose, into which it is inserted. The *second* is *internal*, and is hid in the cavity of the Nostril under the inner coat that covers it: it is membranous, and arises from the extremity of the bone of the Nose, where the cartilage is joined to it, and is inserted into the *Ala*. The former being contracted depresses the *Ala*; the latter draws it inwards, and so closes or constricts the Nostril. And to the same end or purpose there is another that serves, (which is common) namely the *orbicularis* of the upper Lip, which by drawing the Lip downwards, doth at the same time constrict the Nostrils.

Bartholin writes, that besides these Muscles, he has sometimes found a small carnosus Muscle reaching streight down from the frontal Muscle (with a broad Basis, but presently growing narrower) and ending about the cartilage of the Nose. Such as have this Muscle can draw their nose (especially its skin) a little upwards: which motion we use, when (as *Horace* speaks) *suspendimus aliquem naso*, we jeer or scoff at one.

C H A P. VI.

Of the Muscles of the Lips and Cheeks.

THE Muscles of the Lips are either *common Muscles* to the Cheeks and Lips, or *proper onely* to the Lips.

The *common* are two on each side. The *first* is called *detrabens quadratus*: this is a thin but broad Muscle, resembling a Membrane interlaced with fleshy Fibres. It hath its beginning from the hinder side of the neck, the shoulder-blade, the *clavicula* and the breast-bone, and mounting up by oblique Fibres to the face, is implanted into the Chin, Lips, and root of the Nose; which parts it draws obliquely downwards. Sometimes it proceeds also to the root of the Ear, and is reckoned for one of its Muscles. It is called *quadratus* or four-square from its shape. When a convulsion happens in this Muscle, it causes the *spasmus cynicus*, which we can imitate voluntarily by drawing down one side of the Mouth.

The *second* is called *Contrahens*, or *Buccinator* ^{2. Contrahens.} the Trumpeter. This lieth under the former, in the upper part of it. It makes up all that part of the Cheek which is distended in blowing hard. It springs from the gums of the upper jaw, and ends in those of the lower. Most Anatomists describe it to be of a round figure. It is thin and membranous, interlaced with divers Fibres, and is knit so close unto the Membrane which covereth the inside of the mouth, that it can hardly be severed from it. This Muscle is not onely of use to move the Cheeks with the Lips, but when it is

is contracted, it turneth in the meat upon the Teeth again, that had got to betwixt them and the Cheek, in chewing of it.

*Muscles
proper to
the Lips.*
1. Attol-
lens.

The Muscles *proper* to the Lips, are *five* pair, and one odd one. The *First* is *par attollens*. If both of these act together, they draw all the upper Lip directly upwards and outwards; but if onely one, then is but one side of the Lip drawn up obliquely. Each springeth from the first bone of the upper jaw, where the Ball of the Cheek is. At its rise it is broad and fleshy: from thence marching obliquely to the fore-part, it is inserted into the side of the upper Lip near to the Nose.

2. Abdu-
cens.

The *Second* is called *Abducens*, and assisteth the motion of the former, or rather draweth the upper Lip more to one side. It ariseth out of the Cavity that is under the Ball of the Cheek with a fleshy but slender and round beginning, and being covered with much Fat, it is implanted into the *frænum* where the Lips meet, at the corner of the mouth.

3. Jugale.

The *third* pair is called by *Riolanus* *Zugomaticum* or *Jugale*, because it arises outwardly from the Jugal Process. It is fleshy and round, and descending obliquely through the Cheek, is terminated near the corner of the Mouth, and serves to draw both Lips upwards sideways; for it is common to them both.

4. Depri-
mens.

The *fourth* pair is the *Deprimens*, which pulleth down the lower Lip. It springeth broad and fleshy from the lower and fore side of the Chin, from whence ascending obliquely, it is inserted into the middle of the under Lip, continuing broad from its origine to its end.

5. Oblique
detrahens.

The *fifth* pair may be called *oblique detrahens*, for it draws the lower Lip obliquely downwards and

and outwards. It springs from the lower side of the lower Jaw with a fleshy and broad beginning, (being sometimes extended to the middle of the Chin) from hence it goes upwards, and growing narrower by degrees it is inserted obliquely into the lower Lip near its corner. Some make but one of this and the immediately foregoing; as also one other of the second and third, but they are indeed distinct.

And these are all of them pairs, one on each side: but this which follows is single, namely the *Orbicularis* or *Constringens*, and is common to both Lips. It is otherwise called *Osculatorius*, because it contracteth the Lips in kissing. This is that which makes the proper figure and soft substance of both the Lips, encompassing the whole Mouth like a Sphincter, which by its orbicular Fibres it constringes or purses up when one is said to simper. It is closely knit to the skin of the Lips, through which it looks red when we are well, and pale when we are sick. Some suppose this to be no Muscle, but a spongy sort of flesh, endued with no true muscular fibres, viz. such as are capable of true Muscular contraction. But I think there is reason enough to acknowledge it for a true Sphincter Muscle, seeing the pursing up of the Mouth can be performed by none of the other Muscles that belong to the Lips.

6. Con-
stringens.

C H A P. VII.

Of the Muscles of the lower Jaw.

The lower
jaw hath
five pair
of muscles.

TH E lower Jaw (for the upper is immoveable; and therefore has no Muscles) is moved upwards, downwards, towards the right and left sides, and backwards. For the performance of these motions five pair of Muscles are appointed, of which there is onely one pair that draweth the Jaw downwards, all the others in some measure upwards, but chiefly the first pair or temporal. The reason why there is so slender a provision for pulling the Jaw down is, because upon the relaxation onely of those Muscles that draw it up, its own gravity is sufficient to make it fall down; but yet that that motion may be performed the more quickly and nimbly in chewing or speaking, Nature has appointed one pair of Muscles to promote it.

1. Temporal.

The first pair of the *Shutters* or drawers up is called *temporale*, and is the strongest and largest. It springeth from the bones of the *frons*; *synsciput* and temples, and from *os sphenoides*, with a fleshy, large and semicircular beginning, and on its outer side is covered with the *pericranium*, its inner lying next the *periosteum*. Its Fibres the further they are from its middle, the more obliquely are they carried towards its Tendon, for the further it descends, the narrower (but thicker and more carnous) it grows; and at length passing under the *os jugale*, it embraceth and is inserted into the

the thin and broad process of the lower Jaw (called *κεφάλυν*) with a short but very strong Tendon. *Spigelius* says, this Tendon is extended through the whole Muscle, in the midst of its fleshy substance. Whence it is that if this Muscle be wounded and inflamed, most bitter pains and dangerous symptoms ensue, partly because the Tendon passeth so; partly because it is covered with the *pericranium*. This Muscle forcibly pulleth up the lower Jaw, and so shutteth the Mouth.

Why the wounds of the temporal muscle are dangerous.

The second is called *masseter*, because it serveth for chewing by moving the Jaw to the right and left sides: from its situation it may be called *lateralis*. This hath two beginnings; one of which is nervous, large and strong, springing from the suture where the first bone of the Jaw is joined to the fourth; the other fleshy, proceeding from the *os jugale*, from whence marching towards the Chin, it is implanted into the whole breadth of the lower Jaw strongly. The Fibres of this Muscle, by reason of its two beginnings, cross one another; so that it does not onely move the Jaw laterally, but backward and forwards also: upon which account some esteem it a double muscle.

2. Masseter or laterale.

The third pair is called *pterygoideum externum*, *3. Aliforme externum*, or *maxillam abducens*. This hath also a double beginning, partly nervous and partly fleshy; springing partly from the upper external sides of the wing-like process of the *os sphenoides*, partly from the rough and sharp line of the same bone. Whence marching down with streight Fibres, it becometh greater and thicker. And at length is inserted by a strong Tendon into the inside of the *condyloides* process of the lower Jaw,

3. Aliforme externum, or maxillam abducens.

H h

under

under the Tendon of the temporal Muscle. This moveth the Jaw forward, whereby the teeth of the lower Jaw are made to stand further out than those of the upper.

4. Aliforme internum, or maxillam adducens.

The fourth pair is termed *maxillam adducens*, or *pterygoideum internum*. This draweth the Jaw towards its head, or backward. This, in the beginning being nervous, doth spring from the inner cavity of the wing-like Process of the *os sphenoides*; then becoming fleshy, large and thick, and marching down by a streight passage, it is inserted into the inner and hinder part of the lower Jaw by a nervous, broad and strong Tendon. Besides its more proper action of drawing the Jaw backwards, it also helps the Temporal Muscle to draw it up, and so do the second and third pair in some measure, wherefore we rank all these four amongst the *Shutters*.

5. Depri-mens or biventre.

The fifth and last pair opens the Mouth by pulling down the Jaw, whence it is called *Depri-mens*, and otherwise *digastricum* or *biventre*, because it hath two bellies. Anatomists commonly reckon this for the second pair of the Movers of the lower Jaw, but seeing it has a distinct office from the other four, we have plac'd it last. It has its beginning from the *Styloides* process of the Temple-bone, where it is nervous and broad; and afterwards becoming fleshy, small and round, it passeth downward, and in its middle where it cometh to the flexure of the lower Jaw-bone, it loseth its fleshy substance, and degenerates into a nervous and round tendon; but by and by it becomes carnous again, and going along the inner side of the lower Jaw is inserted into its forepart under the Chin. It loses its fleshy substance and becomes

becomes tendinous in its middle, that it may give way to the Jugular Vein ascending in that place. This Muscle, as has been said, draws down the Jaw, in which action some think it is partly assisted by the *par quadratum* described in the foregoing chapter.

CHAP. VIII.

Of the Muscles of the Ear.

THE Ear consists of an *outer* and an *inner* part; and each has its proper Muscles.

The *outer* part is moved but very obscurely, because in Men the Muscles are exceeding small; so that *Galen* calls them, only lineaments or resemblances of Muscles. There are commonly reckoned *four* of them, which by their situation seem fit to move this *outer* part of the Ear (called *auricula* by *Spigellius*, to distinguish it from the *inner* part called *auris*) four manner of ways.

The auricula hath four muscles.

The *first* is called *attollens*. This is seated in the fore-part of the Face, and lies upon the temporal Muscle that draws up the lower Jaw. It arises at the outer side of the frontal Muscle (where it is contiguous to the temporal) with a thin and membranous beginning; and by degrees becoming narrower as it goeth down, it is inserted into the upper part of the Ear, which it moveth upwards and forwards.

1.

The *second* is called *detrahens*. This riseth broad and carnosous from the mammillary Process, and growing narrower is inserted into the root

2.

of the cartilage of the Ear sometimes by two, sometimes by three Tendons. It draweth the Ear upwards and backwards.

3. The *third* is called *adducens ad anteriora*, whereby the Ear is drawn forward and downward. This is but a particle of the *musculus quadratus*, that pulleth down the Cheeks, described before, which ascending with its Fibres, is implanted into the root of the Ear.

4. The *fourth* is *abducens ad posteriora*, which draws the Ear backward. This hath its beginning in the back-part of the Head, from the Tunicles of the Muscles of the *occiput*, above the *processus mammillaris*, where it is narrow, but waxing broader it is carried downward transversly, and is inserted into the Ear behind. All these Muscles in Horses, Oxen and the like, are very large to what they are in Men (yea they have more than these) whereby they can move their Ears more strongly and apparently, to shake off Flies or any thing that offends them.

Monf. du Verney onely reckons two Muscles of the Auricle, the first of which, he says, is made up of certain carnous fibres arising from that part of the *pericranium* that covers the Temporal Muscle, from whence descending in a streight line it inserts it self into the upper and backpart of the *concha*. The second, he says, likewise consists of five or six carnous fibres, that take their rise from the upper and foremost part of the *processus Mastoideus*, and descending obliquely for about an inch terminate at the middle of the *Concha*.

The auris
three.

I.

In the inner part of the Ear (called *Auris*) there are three. The *first* is called *externus*. It is small, springing pretty broad from the upper part of the *meatus auditorius*; then becoming narrower it grows

grows into a very fine and small Tendon, which being carried contiguous to the *tympanum*, is inserted into the longer process of the *malleus*. The handle of which *malleus* adhering to the *tympanum*, when the *malleus* is moved by this Muscle, the *tympanum* is so also, both of them being drawn a little outward and upward.

The second is called *internus*. This is very small, and is placed within the *os petrosum*. It hath its beginning in the basis of the wedge-like bone, there where it is joined with the *processus petrosus*, and at about its middle it is divided into two small Tendons, whereof the one is inserted into the shorter process of the *malleus*, and the other into the neck or handle of it. This draws the head of the *malleus* obliquely forward, and pulls it inward from the *incus*, and together with the *malleus*, it draws the *tympanum* also inwards to which the handle of the *malleus* is affixt.

These two *duVerney* reckons for Muscles of the *Malleus*, and he describes a third belonging to the *Stapes*, which (I think) no former Anatomist hath observed. He says, it is hid within a quill-like cavity formed in the *os petrosum* almost at the bottom of the barrel, from whence it takes its rise. Its belly is thick and carious, and in a little space it ends in a very loose tendon, which inserts it self into the head of the *Stapes*. The cavity which contains the belly of the Muscle is about the sixth part of an inch long, and is much wider than the hole by which the tendon of the Muscle passes.

CHAP. IX.

Of the Muscles of the Tongue.

THE Tongue being the chief Instrument of Speech, and a part which serves to roll the Meat in the Mouth this way and that way, has all manner of motions, being moved forward and backward, upward and downward, to the right hand and to the left; it is also stretched out broad, or contracted. Its Muscles are either proper to it self, or common to it with the *os hyoides* (to be described in the next Chapter.)

The tongue
has five
pair.

1.

It has five pair of proper Muscles. The first is *genioglossum*, so called from its rise and insertion (*γενειον* the Chin, and *γλωσσα* the Tongue) as most of the rest are. This pulleth the Tongue forward without the Teeth and Lips. It springeth from that rough part which is in the middle of the Chin, in the inner and lower side of it; and is inserted into the lower side and towards the root of the Tongue.

2.

The second is called *psiloglossum* (on the same account.) It riseth from the middle and upper part of the *os hyoides* or *psiloides*, and ends in the middle of the Tongue, which it draws streight backwards or inwards.

3.

The third is called *Myloglossum*. This springeth from the inner part of the lower Jaw, where the farthest grinding Teeth are, (whence it has its name) and is inserted into the ligament by which the Tongue is tied to the fauces. Authors differ about the use of this pair; some thinking that it draws the Tongue downward; others, that if both

both of them act together, they draw the tip of the Tongue streight upward and backward to the Palate and upper Teeth; if but one, that it draws it obliquely upward toward its own side.

The *fourth* is called *Ceratoglossum*, because it ariseth from the *horn* of the *os hyoides*. It is inserted into the side of the Tongue. If both of these be contracted at once, they draw the Tongue streight downward and inward; but if onely one, then is the Tongue drawn obliquely to that side.

The *fifth* pair is called *Styloglossum*, because it ariseth from the *styloides processus* of the Temple-bone; from which springing fleshy and small, but afterwards becoming broader and thicker, it is inserted into the side of the Tongue, at about the middle of its length. If both these act together, they pull the Tongue upward and inward; but if one onely, then to the right hand or to the left.

CHAP. X.

Of the Muscles of the Bone of the Tongue, called os Hyoides.

THIS Bone is moved upwards, downwards, forward, backward, and toward the sides; as the Tongue is; for seeing it is fixed to the root of the Tongue, they must needs accompany one the other in their motions; so that the Muscles that are inserted into this bone, moving the tongue also, they are esteemed *common* to both.

To perform these motions it hath *four* pair of Muscles. The *first* is called *Sternohyoideum*. This *four* pair of Muscles. The *first* is called *Sternohyoideum*. This *four* pair of Muscles. The *first* is called *Sternohyoideum*. This *four* pair of Muscles.

H h 4

spring- I.

Os hyoi
des hath

springing from the upper, but inner part of the *sternum* with a broad and carnous beginning, and ascending under the Skin of the Neck by the Wind-pipe, still keeping the same largeness and substance, is inserted in the root or *basis* of the *hyoides*, which it moveth (and the Tongue with it) downward and backward.

2. The *second* is opposite to this, and is called *geniohyoideum*. This springing from the inner part of the Chin, (by the *genioglossum*) fleshy and broad, is inserted into the upper part of the *Basis* of the Bone, where a cavity is made to receive its tendon, and draweth it freight upwards and a little forwards.

3. The *third* is called *Coracohyoideum*. It riseth from the upper side of the *scapula* near the *Coracoides processus*, having a carnous beginning, and lurking under the *Levator* of the shoulder-blade, called *musculus patientiae*, it ascends under the *par mastoides* that bends the Head, where it loses its fleshy substance, and degenerates into a nervous and round Tendon. But as soon as it is past this, it becomes carnous again, and so continues till it is inserted into the horns of the *os hyoides*. Considering its slenderness it is the longest Muscle of the Body, and has two Bellies like the *par deprimens* that pulls down the lower Jaw. The reason of its becoming tendinous in the middle, *Spigelius* thinks to be, that it may make way for the *par mastoides*, as being more worthy than it self: but *Dr. Croone* is of opinion, that the reason is, that it may give way to the *Carotides* ascending under it. Its office is to pull the Bone obliquely downwards.

4. The *fourth* is *styloceratohyoideum*. This riseth from the root of the *processus styloides*, and endeth in

Chap. XI. Of the Muscles of the Larynx.

473

in the root of the horn of the *os hyoides*, which it draweth obliquely upward.

C H A P. XI.

Of the Muscles of the Larynx.

THE Larynx consists of four Cartilages (besides the *Epiglottis*) of which we have treated in Book 2. chap. 14. of these onely three are moveable, viz. the *thyreoides* or buckler-like which is one, and the *arytænoides* or Ewer-like which are two. By these latter is the *rimula* of the *glottis* formed, for the widening and straining, or opening and shutting whereof the muscles of the Larynx serve. These are divided into *common* and *proper*. The common spring from other parts, but are inserted into one of the Cartilages; the proper both arise from and are inserted into them. The common are two pair, viz. *hyothyreoidæum* and *sternothyreoidæum*.

The Larynx hath two pair of common muscles.

The *Hyothyreoidæum* springeth from the whole basis almost of the Bone of the Tongue, having a broad and carnous beginning; from whence descending with streight Fibres, and covering all the outside of the cartilage *thyreoides*, it is inserted into its lowest part. When this is contracted, it draws the buckler-like (or *thyreoides*) cartilage upwards and inwards, and thereby straiteneth the Chink of the Larynx.

I.

The *Sternothyreoidæum* ariseth from the upper and inner part of the *sternum* with a carnous and broad beginning, from whence ascending with streight

2.

streight Fibres up by the sides of the Wind-pipe (continuing the same largeness and substance) it is at last inserted into the lower side of the buckler-like cartilage, by drawing down which it opens or widens the Chink. *Diemerbroeck* assigns clear contrary actions to these Muscles, viz. that the former widens and this latter straitens the *rimula* of the *Larynx*.

Five pair
of proper.

The proper are five pair, (or onely nine Muscles as some reckon, esteeming the fifth pair to be a single Muscle.) The first pair is called *Cricothyreoideum anticum*. This springeth from the fore-part of the *cricoides* or ring-like cartilage, (viz. that which is immoveable) and is inserted into the lateral parts of the *Thyreoides*, which it moves forwards, and so widens the *rimula*, for the forming of a big voice. *Bartholin*, from the insertion of the Nerve, says it arises from the *thyreoides*, and is inserted into the *cricoides*. Also if this pair be very broad, he says, it may be divided into two pair (which *Riolanus* has done) and then the second may be called *Cricothyreoideum laterale*.

2. The second pair, which is called *Cricoartratoideum posticum*, springeth carnosus from the hinder and lower part of the *Cricoides*, and ascending with streight Fibres is inserted with a nervous end into the lower side of the *Arytaenoides*, serving to pull its two cartilages sideways, and thereby to open and widen the *Larynx*.

3. The third is *Cricoartratoideum laterale*, which springeth from the side of the *Cricoides*, where it is broadest, with a slender beginning, but growing presently larger, it is implanted into the side of the *Arytaenoides*, in that part that the foregoing did not cover. This openeth the *Larynx* by drawing the cartilages obliquely aside, and so assisteth the action of the former.

The

The fourth pair is called *Thyreohyoarytenoideum*. This is internal, carnosus and broad, arising from the fore interior part of the *Thyreoides*, and is inserted into the side of the *Arytenoides*, whose cartilages it draws the one towards the other, and so straitens the *Larynx*.

The fifth and last is reckoned by some for a pair, and by others but for one Muscle. It is called *Arytenoideus*, because it has its rise from and insertion into the Cartilage so called. Its rise is at the hinder Line of the Cartilage, from whence being extended with transverse Fibres, it is inserted into the side of the same, and by constringing of it straitens the *Larynx*.

These are the Muscles that perform the motions of the *Larynx*; but as to the use of each particular, Authors disagree very much. Dr. Croone gives this general rule to understand their uses, That those which lie on the fore side of the *Larynx*, serve to open or widen the *rinnula*; and those which lie on the hinder side, to straiten or shut it. To whose opinion great deference is owing.

As for the *Epiglottis*, which is reckoned for the fifth cartilage of the *Larynx*, though in some Brutes it have Muscles, yet Anatomists generally agree that in man it has none, nor is moved with a voluntary motion, but is onely depressed by the weight of what is swallowed, and by the drawing of the tongue backward or inwards; which motion being over, the *Epiglottis* stands up again in its natural and proper posture, and so opens the *Larynx*.

CHAP. XII.

Of the Muscles of the Uvula, Palate and Throat.

The Uvula
said to
have two
pair of
muscles.

THE Uvula is said by *Veslingius*, *Riolanus*, *Hall* &c. to have two pair of Muscles to hold it up; of which one is called *Pterygostaphilinum externum*, which springeth from the upper Jaw, a little below the furthestmost Grinder, and is inserted into the side of the Uvula. The other *Pterygostaphilinum internum*, proceeding from the lower part of the internal wing of the *pterygoideus Processus*, and inserted into the Uvula in like manner. But these Muscles are very hard to discover: and indeed there seems no occasion for them, seeing the Uvula has no apparent motion, and its own frame seems sufficient to suspend it.

The Palate
hath one
pair.

From the aforesaid wing-like process (of the *os cuneiforme*) does there another pair of Muscles arise, first found out by *Dr. Croone*, and by him called *Pterygopalatinum*. Its insertion is into the roof of the mouth by the side of the palatine gland (described in Book 3. chap. ult. from *Steno*.) Its use is very obscure; but perhaps in strong hawking it may serve to compress the said gland a little, and to squeeze out of it some of that humour that is separated in it.

The throat
hath three
pair and a
sphincter.

The Throat, or the beginning of the *oesophagus*, called *pharynx*, hath seven Muscles, to wit, three pair and a sphincter.

I.

Of the pairs, the first is *Sphenopharyngeum*. This springeth from the sharp point of the *os sphenoides* with a small and nervous beginning, and passing downward, ends in a fine Tendon, which

which is inserted obliquely into the lateral part of the Palate and Pharynx, which it widens in swallowing.

The second pair is called *Cephalopharyngeum*, and springeth from that part where the Head is joined to the first vertebra of the Neck; from whence marching down, it is spread about the Pharynx with a large plexus of Fibres, and seemeth to make its Membrane. This straitens the Throat in swallowing.

The third is *Stylopharyngeum*. This springing from the styloides Process of the Temple-bone, is inserted into the sides of the Pharynx to dilate it.

That which hath no fellow is called *oesophagus*. This arises from one side of the Thyroides cartilage, and circularly encompassing the Pharynx with transverse Fibres, is inserted into the other side of the Thyroides; and serves to contract the Mouth of the Gullet, as the sphincters of the anus and Bladder do those parts.

C H A P. XIII.

Of the Muscles of the Head.

THE Muscles of the Head are either common, or proper. The common are those which move the Head together with the Neck, which are to be described in the next Chapter.

The proper are those which onely move the Head, the Neck remaining unmoved, and these are in number sixteen, or eight pair, and move it either

The muscles of the Head are common, or proper.

The proper are eight pair.

either forward or backward, to one side or the other, or about.

1. The first pair, called *Mastoidæum*, bend the Head forward, if both act together; but on one side obliquely, if but one. These have each a double beginning; one nervous from the top of the *sternum*, the other carnosus from the upper side of the *clavicula*; which origines joining, it becomes wholly carnosus, and ascending obliquely by the Neck, at last is inserted with a carnosus end into the Mammillary (or *mastoides*) process of the Temple-bone. This is the onely pair that is placed in the fore-part, and bows the Head forward; all the rest are seated behind, of which the five next bend it backwards if both act, (which is called extending of the Head) or a little sideways if but one; and the two last serve to turn it about.

2. The second pair is called *splenium* or *triangulare*. It rises with a nervous beginning from the spines of the five uppermost *vertebræ* of the *Thorax*; and of the five lowermost of the Neck; from whence ascending and becoming thick and carnosus, it is implanted into the *occiput* with a broad and fleshy end.

3. The third is called *complexum* or *trigeminum*, because it has so plainly a threefold beginning, that it seems to be a compound of three Muscles. One beginning is from the transverse Processes of the fourth and fifth *vertebræ* of the *Thorax*, a second from those of the first and second of the same, and a third from the spine of the seventh *vertebra* of the Neck: All which in their ascent being united into one, are inserted into the *occiput* sometimes by one and sometimes by a triple Tendon.

4. The fourth pair is called *parvum* & *crassum*, because

because it is but a little one, yet pretty thick. This lieth under the third pair. It arises nervous from the transverse Processes of the six uppermost *vertebrae* of the Neck, and is inserted into the hinder root of the mammillary Process.

The *fifth* pair is *rectum majus*. These springing from the tip of the spine of the second *vertebra* of the Neck, are inserted into the *occiput*.

The *sixth*, *rectum minus*. These lie under the former, and proceeding from the back-part of the first *vertebra* end into the *occiput*.

These five last serve all to bow the head backward or extend it: the two following turn it about, as was observed before.

The *seventh* is *obliquum superius*. This pair lies under the two *recta*, answering to them in substance and form. It springs from the transverse Process of the first *vertebra* of the Neck, and is implanted into the *occiput* by the outer side of the *recta*. Some say its rise is here, and its insertion into the *vertebra*.

The *eighth*, *obliquum inferius*. This rises from the spine of the second *vertebra* of the Neck, and is inserted into the transverse Process of the first *vertebra* of the same. So that having both its rise and insertion in the Neck, it might justly be reckoned for a Muscle thereof, and so should have been described in the next chapter: but we have ranked it amongst those of the Head, partly from the authority of most Anatomists who generally have done so, and partly because the first *vertebra* into which it is inserted, always follows the motion of the Head, as shall be shewn in the next Book chap. 10. Of the use of these two last pairs we have spoken already.

C H A P. XIV.

Of the Muscles of the Neck.

The muscles common to the head and neck are four pair.

TH E Head is not onely moved by the proper Muscles abovesaid primarily, but secondarily also by these of the Neck, which are therefore called *common*, and are eight in number, on each side four. The first and second pair bend the Neck and together with it the Head directly backward, or obliquely; the third and fourth directly forward, or to one side, as both or one act.

1. The first is called *Spinatum*. This proceeding from the roots of the *spinæ* of the seven upper *vertebræ* of the *Thorax*, and of the five lowest of the Neck, is inserted strongly into the whole lower side of the spine of the second *vertebra* of the Neck.

2. The second, *Transversale*. This rising from the transverse Processes of the six upper *vertebræ* of the *Thorax*, is inserted into the outside of all the transverse Processes of the *vertebræ* of the Neck.

3. The third, *longum*. This being placed under the *æsofagus*; doth spring from the bodies of the fifth and sixth *vertebræ* of the *Thorax*, and as it ascends is knit to the sides of the bodies of all the *vertebræ*, till it come to the first or highest of the Neck, where each touching other, they are both inserted into its process, which answers to the body of the other *vertebra*.

4. The fourth, *triangulare*, or *scalenum*. It proceeds carnosus from the first rib, and is inserted into the inside

inside of all the transverse Processes of the Neck, except sometime the first and second. It is perforated to make way for the Veins and Arteries which pass to the Arms. The uses of all these pairs were shewn at the beginning of the chapter.

CHAP. XV.

Of the Muscles of the Thorax:

HAVING done with the Muscles that belong to the Head, the highest Venter, we come now to those of the middle or Thorax, which assist respiration. Of these some dilate the Breast in inspiration, some contract it in expiration.

Of the Dilaters the first is called *par Subclavium*. The dilaters. This ariseth fleshy from the inner part of the *clavicula* near the shoulder-point, and passing obliquely (or almost transversly) is inserted into the first Rib, near to the Sternum.

1.

The second is *ferratum majus anticum*. This arises from the inside of the basis of the Shoulder-blade, and the two uppermost true Ribs, and is inserted into the five lowest true Ribs, and two uppermost bastard Ribs, before they end into cartilages. It is called *ferratum* or Saw-like, because its unequal extremities being intermixed with the like unequal beginnings of the obliquely descending Muscle of the Abdomen, imitate the Teeth of a Saw.

2.

The third is *ferratum posticum superius*. This lying under the *rhomboides*, (or fourth Muscle of the Scapula) springeth membranous from the spines of the three lowest vertebrae of the Neck, and

3.

of the first *vertebra* of the Back, and is inserted into the three or four uppermost Ribs.

4. The fourth is *serratum posticum inferius*. This ariseth from the spines of the three lowest *vertebrae* of the Back, and of the first of the Loins, and is inserted into three or four of the lowest (short) Ribs.

5. Fifthly, The eleven external *intercostals*, which perform the office but of one Muscle. These spring from the lower part of the upper Rib, and are inserted into the upper part of the lower Rib obliquely.

There is another Muscle besides these, that assists the widening of the Breast, namely the *Diaphragm*: but of it we spoke at large in *Book 2. chap. 3.* where the Reader may find its Description and Use.

The con-
tracters.

- These that follow contract the Breast. First, the *par triangulare*. This arising from the middle Line of the *sternum*, is inserted into the bony ends of the third, fourth, fifth and sixth true Ribs (where they are joined to the Cartilages.)

2. The second is *sacrolumbum*. This arises from the edge of *os illeum*, the upper part of *os sacrum*, and the spines of the *vertebrae* of the Loins; and ascending up to the Ribs, is implanted into each of them in their lower side, about three Fingers breadth from the spine, by a particular Tendon. (*Diemerbroeck* describes another pair opposite to this (which he calls *cervicale descendens*) springing from the third, fourth, fifth, sixth and seventh *vertebrae* of the Neck, and is inserted into the upper side of each Rib as the *sacrolumbum* is into the lower. And says, that this pair by pulling the Ribs upwards in inspiration widens the Breast, as the other by drawing them down in expiration straitens

Chap. XV. Of the Muscles of the Thorax.

483

straitens it.) Thirdly, The eleven internal intercostals, which are as one Muscle. These pass obliquely from the lower to the upper Rib. Their Fibres run a contrary course to those of the external, crossing of them like the strokes of the Letter X.

3.

I place the *Internal Intercostals* among the *Contractors* of the Breast, as also the *External* among the *Dilators*, because most Anatomists have done so; though some there are that think the internal dilate it, and the external contract it. Yea Dr. *Mayow* is of opinion that they both of them dilate it. For going upon this supposition, that the *Thorax* is widened by drawing the Ribs upward, he thinks them both equally adapted for that action. For seeing in all muscular motion the part that is less firm, is moved towards that which is more firm, and that each lower Rib successively is jointed looser than that immediately above it, it must needs be, that the internal upon their contraction draw the Ribs upwards as well as the external, and that not obliquely, but directly. For by their crossing one another they hinder the *obliquity* of one anothers motion (for which each severally is fitted) and so perform the same motion as if their fibres descended straight from the upper Rib to the lower; which course of fibres was not convenient here, because of the small space betwixt one Rib and another, which would not permit them to have that length which the nature of Muscles requires.] Thus that ingenious person discourses, I think very probably. These Muscles of respiration are much assisted in their action, secondarily, by the Muscles of the *Abdomen*, *scapula* and *Arms*, which shall be described in their proper chapters.

The use of the intercostal muscles.

C H A P. XVI.

Of the Muscles of the Back and Loins.

The back
and loins
have four
pair.

1.

THE Back, but especially the Loins, being moved diversly, viz. backward and forward and to the sides, into every vertebra there are Tendons of Muscles inserted, as if there were a great many Muscles in all. But there are but four (proper) pair to assist the motion of both.

The first pair are two triangular Muscles, which being joined together make a kind of a quadrature, and are therefore called *par quadratum*. These arise broad and thick from the hinder upper cavity of *os ileum*, and the inner side of *os sacrum*, and are inserted into the transverse Processes of the vertebrae of the Loins even up to the lowest Rib. If both these act together, they bow the vertebrae of the Loins straight forward, if one alone, obliquely forward.

2.

The second and principal pair are the *musculi longissimi*. This springs from all the spines of *os sacrum* and of the vertebrae of the Loins, and also from the inside of *os ileum* where it is joined to the *sacrum*; from whence it ascends all up the spine, and terminates in the *processus mammillaris* of the Temple-bone, in its way lying upon the transverse processes of the Lumbar vertebrae, and bestowing Tendons on the transverse Processes of all the vertebrae of the Back, (whence some have divided this Muscle into as many as there are vertebrae.) It is almost confounded with the two following from its rise till the lowest vertebra of the Thorax, where it begins to be separated from them.

Ch. XVI. Of the Muscles of the Back and Loins. 485

them and leaves them. But so far as they accompany it, it is so very difficult to separate and distinguish them, that some account all three but for one.

The *third* pair are the Muscles called *sacri*. This arises behind from the *os sacrum*, with an acute and fleshy beginning, and ends in the spine of the lowest *vertebra* of the *thorax*, and for the most part also is inserted, by the way, into the spines and oblique Processes of the *vertebrae* of the Loins. This helpeth the action of the former.

3.

The *fourth* and last pair are the *semispinati*. This springs by a nervous beginning from all the spines of *os sacrum* and the Loins, and ends in the transverse Processes of the *vertebrae* of the Loins, and of the lowermost of the *Thorax*. *Spigelius* says, it arises from the spine of the lowest *vertebra* of the Back, and ends in the spine of the first; by the way bestowing tendons on all the spines, as the *Longissimi* did on the transverse processes. Others describe it otherwise. The truth is, it is so almost impossible to separate and raise these Muscles of the Back and Loins, that 'tis no wonder Authors differ so much in their number and description.

4.

But how many soever they be, or wheresoever be their rise and insertion, the use of them all is to erect the trunk of the body by bending the Back and Loins backward, except the first pair which bow it forward, in which action they are much assisted by the *recti* of the *Abdomen*, which we shall describe in the next Chapter.

CHAP. XVII.

Of the Muscles of the Abdomen.

IN the first Book, Chap. 3. where we discoursed of the *common* containing parts of the *Abdomen*, or lowest *Venter*, we onely barely mentioned its Muscles, deferring the description of them till this place, where it seems more proper.

The Ab-
domen
hath five
pair.

I.

The *Abdomen* then hath ten Muscles, five on each side. The first pair is *Obliquè descendens*. It springeth from the lower side of the sixth, seventh, eighth, ninth, tenth and eleventh Ribs, (before they pass into cartilages) by so many distinct acute beginnings: and each presently spreading it self, in a short space they grow into one Muscle. These several beginnings appear somewhat like the teeth of a saw, and are intermixed with the saw-like tendons of the *serratus major anticus* of the Breast, as when one thrusts the fingers of one hand betwixt those of the other. Besides these origines it is said also to spring from the transverse processes of the Lumbar *vertebrae*: but Dr. Croone thinks that to be a mistake, because those processes are so covered with other Muscles, especially with the *Latissimus dorsi*, that this can by no means spring therefrom. Wherefore he assigns to it in this place another origine, namely from the investing membrane of the said *latissimus*, as he does also to the following pair, who have been also said to arise from the said processes. Lastly, it springs from the *costa* or upper edge of *os Ilium*; from all which places its Fibres descend obliquely forward, and it endeth by a broad Tendon

Tendon in the middle of the Belly in the *Linea alba*; which Tendon cleaves so fast to that of the obliquely ascending (lying next under this) that they cannot be separated without tearing. (The *Linea alba* in which these Tendons end, is a white part or Line running from the *mucronata cartilago* at the pit of the Stomach, down the middle of the Belly by the Navel to the *ossa pubis*, and is made of the concurrence of the Tendons of the Muscles of the *Abdomen*; namely of this pair already mentioned, and of the *obliquè ascendens*, the transverse and pyramidal. Linea alba.

The second is the *Obliquè ascendens*. This lies next under the former, and its Fibres ascending obliquely cross those of the other like an X. It springs from the transverse Processes of the *vertebrae* of the Loins (as has hitherto been taught, but Dr. Croone says, from the investing membrane of the *latissimus dorsi*) and the spines of *os sacrum* with a membranous beginning, and from the edge of *os Ilium* with a fleshy. Ascending carnosus from hence it is joined to the cartilages of the eighth, ninth, tenth and eleventh Ribs, and ends in the *linea alba* with a broad and nervous Tendon. 2.

Note, that the Tendons of both these oblique Muscles (as also those of the transverse) are perforated in the bottom of the *Abdomen* for the descent of the spermatick vessels into the *scrotum*.

The third pair is the *Rectum* or straight. This arises fleshy from the lower part of the *sternum*, from the side of the *cartilago mucronata*, and from the cartilaginous ending of four Ribs; and so marching straight down along the Belly, it is inserted by a strong Tendon into the *os pubis*. It hath sometimes three, sometimes four transverse inscriptions or intersections, that appear tendi- 3.

nous: whence some divide each Muscle into four or five Muscles, accordingly as they have three or four Intersections. And indeed if *Galen's* Rule be true, that wheresoever the Nerve is inserted into the Muscle, *there* is its head; we must confess they are distinct Muscles. For Nerves are inserted into both their upper and lower parts, and into each of those that lye betwixt the Intersections. And by supposing them thus distinct, we may conceive how they may better perform their primary action, which is, strongly to compress the Belly for the expulsion of the *faces* or *fetus*. Under these Muscles do the *Arteriae* and *Venae mammariae* descend to about the Navel, as the *Arteriae* and *Venae epigastricae* ascend under them to near the same place; and these were held to inosculate one with another, (the descending with the ascending) till of late that such inosculatation is discovered to be merely imaginary.

4. The fourth pair is the *pyramidal*. These Muscles are seated upon the lower part of the *Recti*, springing carnos from the *ossa pubis* into which the *Recti* are inserted. They are broader at their *basis* and in their ascent grow narrower and narrower till they end in an acute tendon, which is inserted into the *linea alba*, and reaches sometimes as high as the Navel, though their carnos part be but about an hands breadth long. They are said to assist the *recti* in their action, and are for that reason called otherwise *succenturiati*. But they seem to some more particularly to serve to compress the Bladder in making Water; though considering the shortness of their carnos part, and their external situation, 'tis difficult to conceive how they can much assist that action, which most probably is chiefly performed by the proper muscu-

muscular fibres of the bladder it self; but perhaps may be somewhat promoted by all the Muscles of the *Abdomen* as well as this, while they constrict the belly and so press the guts against the bladder; which pressure is remotely owing also to the Muscles of the *Thorax*, especially the Diaphragm. Sometimes one, and sometimes both of these pyramidal Muscles are wanting, and then the ending of the *recti* is broader and more carnosus.

The fifth pair is the *transverse*. These cleave close to the *peritonæum* on their inside: and they are called *transverse*, because their fibres run cross or athwart the Belly. They spring from a Ligament that grows from the transverse processes of the *vertebræ* of the Loins, from *os Ileum*, and the inside of the cartilaginous ends of the lower Ribs, and end in a broad and membranous Tendon in the *linea alba*.

The use of all these Muscles hath been held to be first, when they act not, to defend the *viscera* contained under them from external injuries, and to encrease their heat: and secondly, when they are in action, first to further the excretion of the Excrements; secondly, to help the exclusion of the Infant in labour; thirdly, to assist the Breast in strong expiration and expectoration; and fourthly, to help to bend the trunk of the Body forward in stooping, which is chiefly done by the *Recti*. But *Diemerbroeck* thinks that the straight, pyramidal and transverse are all that serve for the compression of the Belly, and that the oblique do elevate or dilate it. And he endeavours to prove this to be their action, first, because there will be no Muscles to elevate the parts of the *abdomen*, if these do it not; whereas it is both evident to every ones own observation in

in himself, that the *abdomen* is alternately elevated and depressed, and such an alternate elevation and depression seems necessary for the furthering the motion of the Aliments and Humours through the parts contained in the lower Belly. *Secondly*, he appeals to their oblique situation, which is inconvenient for pressing. *Thirdly*, he thinks their rise and the length of their tendons evince, that their use is not to compress. For he says, when their fleshy part grows tumid, they draw the tendons with the *linea alba* outwards and elevate them; and that this intumescence ordinarily concurs with that of the Muscles that dilate the Breast.

C H A P. XVIII.

Of the Muscles of the Genitals, both in Men and Women.

The Penis
hath two
pair.

IN the first Book, chap. 23. of the *Yard*, we described its Muscles and their action, whither the Reader may please to turn, and here we shall but just name them. They are *two pair*. The *first* are the *erectores* or *directores*, which arise from the inner knob of the *coxendix*, and are inserted into the nervous bodies of the *Penis*, near their beginning. The *second* are the *acceleratores*, which arise from the *sphincter* of the *anus*, and passing on the under side of the *Penis* (by the sides of the *urethra*) end about its middle.

The Clitoris
hath
also two
pair.

The *Clitoris* in Women, (something resembling the *Penis* in Men) hath also *two pair* of Muscles, which

which having described Book 1. chap. 29. we shall not insist on here, but remit the Reader thither.

As to the *Cremaster* Muscles by which the *Testes* are suspended in Men, see them described Book 1. chap. 31. As for Womens *Testes*, they have no *Cremasters*.

C H A P. XIX.

Of the Muscles of the Bladder and Anus.

THE Bladder, as was shewn in the first Book Chap. 19. consists of three membranes, whereof the middle is muscular, being endued with carnosus fibres; yea by *Spigelius* it is reckoned for a *Muscle*, and called *detrusor urine*. But in the above-mentioned place we have described it under the notion of a *Membrane*; and what is there said of it may suffice, unless we would enter upon a controverſie of Names.

Excluding that membrane therefore from the number of *Muscles*, the Bladder will have but one, namely its *Sphincter*, which encompasses its Neck, (and environs the Prostates also.) In Men it is about two inches broad, and is generally esteemed to be nothing else but the middle membrane here grown more carnosus than in the rest of the Bladder. Its Fibres are orbicular, and by the contraction of them is the neck of the Bladder constricted or purſed up, so that the Urine cannot pass out unless they be voluntarily relaxed, or rather, unless when they are overpower'd by the contraction and compression of the Muscular membrane,

The bladder hath but one muscle.

membrane, &c. for then they are forced to give way to the Urine. In Women it is not so broad because the Neck of their Bladder is shorter, but it reacheth to the hole by which the Urine passeth into the *vagina uteri*, and seemeth to form it.

The Anus
three.

The *Anus* hath three Muscles. The first is the *sphincter ani*. This is fleshy, and encompasses the end of the streight Gut, being two inches broad. Its Fibres are orbicular. It doth not spring from any adjacent Bone, but onely adheres to the *coccyx*. It serves to purse up the Fundament, and so hinders the involuntary evacuation of the *fæces*. The second and third are called *levatoræ*. These spring from the inside of the Ligaments of the *coxendix* and *os sacrum*, being broad and membranous, from whence passing by the sides of the streight Gut, they stick to it, and are inserted into the upper part of the *sphincter*. These draw up the Fundament again after it is made to strut out in straining to stool; yea they prevent its falling out, which sometimes happens upon their violation.

CHAP. XX.

Of the Muscles of the Scapula or Shoulder-blade.

THUS we have done with the Muscles of all the three *Venters*: now we cometo those of the *Limbs*. And first of the *Scapula* or *Shoulder-blade*.

It

It is moved forward, backward, upward and downward, and for the performance of these motions hath four proper Muscles. The first is called *trapezius*, as also *catallaris*, because it with its fellow covering the Back resembles a Monk's Cowl. It ariseth fleshy from the lower part of the *occiput* towards the Ear; but from the posterior Processes or spines of the five lowest *vertebrae* of the Neck, and of the eight uppermost of the *Thorax* it springeth membranous. Being thus broad at its rise, it grows narrower in its progress, and is inserted into the whole spine of the *Scapula*, into the Shoulder-point, and broader part of the *clavicula*. Now through its large beginning and indifferent narrow tendon or end, it comes to pass that its fibres hold a various course; some of them being *streight*, others *obliquely descending*, and others *obliquely ascending*. Whence it is also that it performs divers offices; for it draws the *scapula* directly backwards by its *streight* fibres, (which spring from about the first and second *vertebrae* of the *Thorax*;) obliquely downwards, by the obliquely ascending, (which arise *below* the *streight*;) and obliquely upwards, by the obliquely descending, (which arise *above* the *streight*.)

Each Scapula hath four muscles.

1.

The second is *levator*, or *patientia musculus*, so called from its helping to shrug up the Shoulders, when we would intimate that there is no remedy but *patience*. This hath its beginning from the transverse Processes of the first, second, third and fourth *vertebrae* of the Neck; which beginnings being united about the middle of the length of the Muscle, it is at length inserted by a broad and car-nous tendon into the upper corner of the Shoulder-blade, which it draws upward, and (as Authors say) somewhat forward.

2.

The

3. The third is *ferratus minor anticus*. This lies under the pectoral Muscle, and springs from the four uppermost Ribs (except the first) before they become cartilaginous, by four fleshy portions representing the Teeth of a Saw, and is inserted by a broad Tendon near to the Anchor-like Process of the *Scapula*, which it draws forward towards the Breast.

4. The fourth from its figure is called *Rhomboides*. This is placed immediately under the *Cucullaris*. It springeth fleshy from the hinder Processes or spines of the three lowest *vertebrae* of the Neck and so many uppermost of the *Thorax*, and is inserted by as broad a fleshy ending, as the beginning was, into the *basis* of the Shoulder-blade, which it draws backward.

Besides these four proper Muscles it hath others that are common to it with other parts, which in some measure assist its Motions, as the *ferratus major*, described above, *chap. 15.* and the *deltoides*, which we shall describe in the next Chapter.

C H A P. XXI.

Of the Muscles of the Arm.

THE *Arm* in common acceptation is meant of all the distance betwixt the Shoulder-point or Neck of the Shoulder-blade, and the Wrist; but we take it more strictly here for that part onely that reaches from the Shoulder to the Elbow, (which it self is otherwise called *umerus*) and consists of one bone, which we shall call the

Shoul.

Shoulder-bone. It hath five motions, for it is moved backward, forward, upward, downward, and circularly. Each arm hath nine muscles.

It is moved upward by two Erectors, *deltoides* and *supraspinatus*. First, *Deltoides* (so called because in shape it resembleth the Greek Letter Delta Δ) springeth nervous and broad from the middle of the *clavicula*, the top of the Shoulder, and the whole spine of the *scapula*, as from so many distinct beginnings. But presently becoming carnous and thick, it grows narrower and narrower in its progress, till it end in a strong tendon (carnous without and nervous within) which is inserted transversely into the middle of the Shoulder-bone, and moves it either upward and forward towards the face, or else backwards, as these or those of its fibres are contracted. And besides its moving of the *humerus*, it helps also to draw up the *Scapula*. Erectors. 1.

The second is *supraspinatus*, or *superfascularis superior*. This arises from the basis of the *Scapula*, and fills up the upper *interscapulium*, viz. all that cavity that is betwixt its spine and upper edge or *costa*; and passing over the jointing of the *Scapula* with the Shoulder-bone, by a broad and strong Tendon is inserted obliquely into the Neck of the latter. Some think this doth not onely lift the Arm upward, but help to turn it about also. 2.

It is pulled down by *latissimus*, and *rotundus major*. *Latissimus* is so called from its largeness; for with its fellow it covereth almost the whole Back. It is called also *ani scalptor*, or *tersor*; because those Offices are performed by the help of this Muscle. It springs by a broad membranous beginning from the hinder Processes or spines of all the Depressors. 1.

the *vertebræ* of the Back-bone, that are betwixt the sixth of the *thorax*, and the middle of *os sacrum*, as also from the upper edge or *costa* of *os ilium*: then passing upwards, when it is come to that part of the Back, where the Ribs begin to bend, it becometh fleshy, and is carryed over the lower corner of the *scapula*, (from which also it often receives many carnous fibres) where becoming narrower, it is inserted into the Shoulder-bone, by a short broad Tendon, between the *musculus pectoralis*, and this that follows, *viz.*

2. *Rotundus major*, or more properly, *teres major*. (For *rotundus* means a thing spherical, but *teres* long and round, like a thread, as this is.) It springeth carnous from the whole lower edge or *costa* of the *scapula*, and is inserted by a short and strong Tendon into the Shoulder-bone, a little below its Neck, and moves it contrary to the *Deltoides*, *viz.* downward and somewhat backward.

Movers
forward.

I.

It is drawn forward by *pectoralis* and *coracoideus*. *Pectoralis* hath a very large and for the greatest part membranous beginning, arising from divers parts, yet is one and continuous. In its upper part it rises from the middle of the *clavicula*; in its middle, from the whole length of the *sternum* and the cartilages of the Ribs annexed to it; in its lowest, from the cartilages of the sixth, seventh and eighth Ribs. It presently becomes carnous and thick, but narrower, and running towards the Shoulder it is inserted into the Shoulder-bone, a little below its Head; between the *deltoides* and the *biceps* of the Cubit. The fibres of this Muscle are of three sorts, *viz.* obliquely descending, streight (or transverse) and obliquely ascending; and accordingly it draws the *os humeri* either directly forward towards the breast by its middle streight fibres, or else

else obliquely forwards, viz. forward and upward, or forward and downward, as the obliquely descending, or obliquely ascending fibres are contracted.

Coracoideus or *Coracobrachialis* springeth from the *coracoides* process of the *Scapula*, and endeth about the middle of the Shoulder-bone, assisting the obliquely descending fibres of the *Pectoralis* in moving that bone obliquely forward and upward.

It is moved backward by three: *Infraspinatus*, *Subscapularis*, or *immersus*, and *Rotundus minor*. Pullers backward.

Infraspinatus or *suprascapularis inferior* springeth from the lower basis of the *Scapula*, and filleth up the lower *interscapulium*, viz. all that space that is betwixt its spine and lower edge, as the *supraspinatus* did that between the spine and upper edge. It is inserted by a broad and short Tendon into one of the Ligaments that strengthen the jointing of the Shoulder-bone with the *scapula*.

Subscapularis or *immersus* possesseth the whole inner cavity of the *Scapula*. It springeth from the inner part of its basis, fleshy, and so continuing, passeth forward (but becoming still narrower) to the Neck of the *Scapula*, and at the last by a broad Tendon is inserted into one of the Ligaments that strengthen the aforesaid Shoulder-joint.

Rotundus minor ariseth from the lowest corner of the *Scapula* by a fleshy beginning, and is implanted into the Neck of the Shoulder-bone. Some make but one Muscle of this and the *Rotundus major*.

As to the circular motion of the Arm, that is not performed by any particular Muscle, but several of these contribute towards it, namely the *supraspinatus*, *infraspinatus* and *subscapularis*, and in some measure the others also.

C H A P. XXII.

Of the Muscles of the Ulna.

THE lower part of the Arm from the Elbow to the Wrist is called the Cubit, and consisteth of two Bones, called *ulna* and *radius*. The *ulna* serveth for flexion, and extension; but the *radius* helpeth to turn the Cubit inward or outward, so as to make the back or palm of the Hand look upward or downward.

Two bend-
ers of the
ulna.

I.

The *ulna* is bended by two, to wit, *biceps*, and *brachii internus*. *Biceps* is so called because it hath two heads, both of which spring from the Shoulder-blade. The one is outward, tendinous and round, springing from the upper brim of the *acetabulum*, or cavity of the *scapula*, into which the head of the Shoulder-bone is received; The other is broader, and is framed partly of a Tendon, and partly of Flesh: it springs from the Anchor-like process of the Shoulder-blade, from whence descending by the inside of the head of the Shoulder-bone, it meeteth with the former, and both together become a strong fleshy Muscle: which lying on the inside of the Arm, afterwards ends in a thick, round, and strong Tendon, which is inserted into the inside of the head of the *Ulna*, (or of the *Radius*, as *Bartholin* will have it.) This Tendon is sometimes pricked in letting blood in the Arm, and then it causeth great pain.

2.

Brachii internus lieth under the *biceps*, being shorter than it, and altogether fleshy. It riseth where the *deltoides* endeth, viz. from the middle

of

of the Shoulder-bone, unto which it cleaveth firmly, and is inserted between the heads of the *ulna* and *radius*, in their fore-side.

The *ulna* is extended by four Muscles, *longus*, *brevis*, *brachiaeus externus*, and *cubitalis*. *Longus* hath two beginnings; the one is partly fleshy and partly nervous, at the lower *costa* or edge of the *scapula*, near its Neck, (where it hath a peculiar hollownes to receive it :) this descends by the inside of the Shoulder-bone, and when it is come as far as the insertion of the *ani scalptor* (described in the foregoing Chapter) there arises another carnous beginning towards the outer side, that (according to *Spigelius*) joins with it and makes up one Muscle, which is inserted into the inner side of the hinder process of the *ulna* called *olecranon*.

Four extenders.

1.

Brevis ariseth from the hinder part of the Neck of the Shoulder-bone, and endeth in the outer side of the *olecranon*; namely, in that part of the Elbow that we lean upon.

2.

Brachiaeus externus (so called by *Riolanus* to distinguish it from the *internus*) is placed towards the outside of the Shoulder-bone, and is confounded with the other two, and endeth where they do. This seemeth to be *Spigelius*'s second beginning of the *longus*, which he says grows into one Muscle with it.

3.

Cubitalis or *anconæus* ariseth from the lower end and hinder side of the Shoulder-bone, and passing over the Elbow-joint, it endeth by a nervous Tendon in the side of the *ulna*, a very little below the *olecranon* or *ancon*, whence it is called *anconæus*. Some make one Muscle of this and the *brevis*.

4.

Note that the fibres of both these benders and extenders of the *ulna* keep all a straight course, and so onely move the Cubit streightwise.

CHAP. XXIII.

Of the Muscles of the Radius.

The Radius hath four muscles.

THE Radius, the other Bone of the Cubit, is moved accidentally (or in common) by the Muscles of the *ulna*, to which bone it is fasten'd; but it has besides, proper motions of its own, and for the performance of these, two sorts of Muscles; of which some are called *pronatores*, viz. those that turn it inwards; and the Palm of the Hand upwards; and others *supinatores*, which turn it outwards, and the Palm of the Hand downwards.

Two Pronatores.

I.

The *pronatores* are two in number. The first is, *pronator superior rotundus* or *teres*. This springeth from the root of the inner knob of the Shoulder-bone at the Elbow, and from the inner side of the *ulna*, where it is joined to the Shoulder-bone; and running obliquely on the inside of the *radius* endeth about its middle in a membranous Tendon.

2.

The second is *pronator inferior quadratus*, which is altogether fleshy. It springeth from the lower and inner part of the *ulna* two Inches broad; then marching transversely above the Ligament which joineth the *radius* to the *ulna*, it endeth in the inside of the *radius*. The ending is as broad as the beginning; wherefore it is called *quadratus* or four-square. The

The *supinadores* are in like manner two. The first is *supinator longus*, so called, because, of all the Muscles which lie along the *ulna*, it hath the longest Belly. This springeth fleshy from the edge of the outer knob of the Shoulder-bone; and marching obliquely under the *radius*, is implanted by a membranous Tendon into the upper side of the lower end of the *radius*, bending somewhat to the inner side.

Two Supinadores.

I.

The second is *supinator brevis*. This springeth from the outside of the ligament which strengthens the jointing of the *ulna* with the Shoulder-bone, and from the hinder Process of the *ulna*, as *Spigelius* describes it; but as others, from the outer process of the Shoulder-bone; from whence it passeth on obliquely, being without membranous, and within fleshy, and is inserted into the middle of the *radius*.

2.

Note, that though for orders sake we have described the Muscles of the *radius* next to those of the *ulna*; yet when one would shew them in Dissection, the Muscles of the Fingers, Thumb and Wrist are first to be raised, and then these of the *radius* after those are taken away.

CHAP. XXIV.

Of the Muscles of the Wrist.

THE *Carpus* or *Wrist* has three Motions: It is either bended, extended, or moved side-ways. For its flexion and extension it has proper Muscles; but as for its motion sideways, that is

The Wrist hath four muscles.

not performed by any proper Muscles, but by a Bender and an Extender of that side to which it is moved, if they act together. The Benders lie on the inside of the Cubit, and the Extenders on the outside.

Two benders.

I.

The Benders of the Wrist are two ; of which the first is *Cubitæus internus* : this ariseth by both a fleshy and nervous beginning from the inner tubercle or knob of the Shoulder-bone ; then passing fleshy the length of the *ulna* or *cubitus*, (to which it immediately adheres) it ends by a Tendon, partly nervous, and partly fleshy, in the fifth bone (some say the fourth of the first rank) of the Wrist.

2.

The second is *Radius internus* : this arising from the same tubercle, passes along the *Radius* (adhering to it ;) and before it comes to its lower end, turns into a round tendon, which proceeding forward grows to the transverse ligament of the Wrist ; but still passing further and waxing broader ; it is at last inserted into that Bone of the back of the Hand which is set before or sustains the fore-Finger.

Two extenders.

I.

The Extenders are also two. The first is *Radius externus*, or *bicornis* : this ariseth by a double origine from that bony tip of the Shoulder-bone, and from the outer knob of the same : then becoming more fleshy, it passeth along the *Radius* to its middle, where it turneth into a strong Tendon, which presently is divided into two almost round Tendons. Both these pass a little asunder by the *radius* under the Ligament of the Wrist, and are one of them inserted into that Bone of the back of the Hand which stayeth the fore-Finger, and the other into the Bone which stayeth the middle Finger.

The

The *second* is *Cubitæus externus*: this hath its beginning from the root of the external knob of the Shoulder-bone: it passes along the *cubitus* or *ulna*, and when it is come to the Wrist, it endeth in a strong round Tendon, which is inserted into the upper part of that Bone which stayeth the little Finger, not far from the Wrist.

2.

C H A P. XXV.

Of the Muscles of the Palm of the Hand.

THE Palm of the Hand is said to have *two* Muscles. The *first* is *Palmaris*, which arise from the inner knob of the Shoulder-bone, round and nervous, but presently becoming fleshy it continues its course along the *ulna*, under all the other Muscles, but about the middle of the said bone it turns into a round Tendon, which passing over the transverse or annular ligament of the Wrist, is afterwards dilated into a broad nervous membrane, which cleaveth firmly to the skin of the Palm of the Hand, (causing it to be of most exquisite sense) and endeth in the inside of the first Joint of the Fingers. This Muscle spreading its Tendon thus in the Palm, besides that it adds much to its sensibleness, helps to contract and wrinkle the skin thereof, for the taking the faster hold in grasping of a thing.

The Palm hath two muscles.

I.

The *second* is *caro quedam quadrata*, or a four-square fleshy substance: this springeth from the *membrana carnosa* that covereth that region where the eighth bone of the Wrist is placed. From

2.

thence it is carried under the dilated tendon of the *musculus palmaris*, to the middle of the Palm of the Hand, and there ends. *Spigelius* says, it is inserted into the outside of the tendon of that Muscle which moveth the little Finger outwards. It looks as if it consisted of two or three Muscles, and serveth (as some think) for the hollowing of the Palm of the Hand, by drawing the outside of it towards the ball of the Thumb; but according to *Spigelius's* opinion, it serves rather to withdraw it, and so to spread the Palm open.

CHAP. XXVI.

Of the Muscles of the four Fingers.

THE Fingers are bended, extended and moved laterally. By the Fingers we mean only the four, excluding the Thumb, whose motion differs very much from that of the other; and therefore we shall describe its Muscles in the next Chapter, as being altogether distinct from these.

Three benders of the Fingers.

I.

The Fingers are bended by three Muscles, (or rather by six.) The first is called *sublimis*, or *perforatus*. This springeth somewhat nervous, from the inner knob of the Shoulder-bone, and descends fleshy betwixt the *ulna* and *radius* till near the Wrist, where it is cleft into four fleshy portions, which presently pass into so many round tendons, all whereof are involved together in one common, thin and mucous membrane, that they may march the more safely. Thus they are carried under the transverse ligament of the Wrist,

Ch. XXVI. Of the Muscles of the four Fingers. 505

Wrist, and along the Palm to the second joint of the Fingers (growing there broader and thinner) into which they are inserted, one into each. *Spigelius* notes, that as they pass along the first joint, they run under a transverse ligament (that springs from one side of the bone and is inserted into the other) as under an arch; which ligament hinders them upon their contraction from starting up out of their places. Near their end each has a fissure or perforation, to give way to the Tendons of the *profundus* passing through.

The *second* is named *profundus*, or *perforans*. This ariseth from the upper parts of the *ulna* and *radius*, a little below the joint of the Elbow, and being cleft at the Wrist into four Tendons, these run (invested in a common membrane) under the annular ligament of the Wrist, and also the transverse ones of the first joint of the Fingers, and lastly through the clefts of the Tendons of the *sublimis*, and are implanted into the third Joint of the Fingers.

The *third* sort of Muscles are called *Lumbricales*, one to each finger. These are very small, and arising from the Tendons of the *musculus profundus*, end each in a round Tendon in the first Joint of the Fingers, being confounded with the Tendons of those Muscles that move the Fingers laterally; yea sometimes they proceed further along with them, by the sides of the Fingers, to the third joint, and assist their lateral motion. The first of these Muscles bends the second joint of the Fingers, the second the third, and the *lumbricales* the first.

The Fingers are extended by *three* Muscles, *Three* Ex-whereof one is *common* to all the four Fingers, *tenders*. and two *proper* to two particular.

The

One com-
mon.

The *common* is *Extensor magnus*. This arising from the outer knob of the Shoulder-bone, a little above the Wrist is divided into four Tendons, which passing the Wrist like the foregoing are inserted into the second and third Joints of the Fingers. Some make two of this, supposing that tendon that is inserted into the little finger, to be the tendon of a Muscle that is distinct from that from which the tendons are propagated to the other three fingers, but grant it has the same origine and keeps the same course.

Two pro-
per.

I.

The two *proper* are one of them called *Indicator*, because it belongeth to the four-Finger. It ariseth from the middle of the *ulna* on its outside, and by a double Tendon it endeth in the second Joint of the fore-Finger: but one of the Tendons becometh one with the Tendon of the *Extensor magnus*.

2.

The other is named *Auricularis*, because it belongeth to the little Finger. It ariseth from the upper part of the *radius*, and marching between the *ulna* and the *radius* it is inserted by a double Tendon into the backside of the little Finger, of which tendons one coalesces with that of the common Extender.

Movers
laterally,
eight.

The Fingers are moved laterally two manner of ways: for either they are brought to the Thumb, or they are carried from it. These Motions are performed by *eight* Muscles, called *interossei*, because they are placed between the Bones of the *Metacarpium*. That is, six of them are placed in the three interstices of the four Bones of the *Metacarpium*, one on the outside of that bone which sustains the fore-finger, and another on the outside of that which sustains the little finger. They are fleshy and round, and spring from

Chap. XXVI. Of the Muscles of the four Fingers. 507

from the Bones of the *metacarpium*, to which they also adhere, as they pass along them. When they are come to the Roots of the Fingers, they pass into Tendons, which cleave to the sides of the Fingers, and end in the last Joint of the Fingers near the root of the Nails. When the Tendons of the *Lumbricales* join with these, they may be reckon'd amongst the Movers of the Fingers laterally, and then there will be twelve in all, the *Lumbricales* being four, and these *interossei* eight; but usually the *Lumbricales* serve onely to bend the first Joint of the fingers, as was shewed above.

Besides these Muscles, the fore-Finger and the little Finger are said to have each one proper Muscle. That of the fore-Finger may either be called *Abducens* in respect of the middle Finger from which it draws it; or *Adducens*, in respect of the Thumb towards which it draws it. It springs from the inside of the first Joint of the Thumb, and ends in the Bones of the fore-Finger, which it pulls towards the Thumb.

That of the little Finger is called *Abductor* (by some *hypothenar*) and springs from the third and fourth bone (of the second rank) of the Wrist; whence proceeding along the palm of the hand, it is implanted by a small nervous tendon into the outside of the first joint of the little Finger, which it draws outwards from the rest.

Abducing muscles, two.

I.

2.

CHAP.

CHAP. XXVII.

Of the Muscles of the Thumb.

Two ex-
tenders of
the thumb.

1.

THE Thumb is extended by two Muscles. The first is called *longior*. This ariseth fleshy from the outside of the *ulna*, near the membranous ligament which tyeth together the *ulna* and *radius*. From thence it is carried obliquely upon the *radius*, and before it come to its *appendix*, turneth into a round Tendon; which passing under the annular ligament of the Wrist, marcheth along that side of the Thumb, which is next to the Fore-finger, and is inserted into its third bone.

2.

The second is named *brevior*. This ariseth from the same origine with the other, and passeth obliquely above the *radius*. By one Tendon it is implanted into the root of the first joint of the Thumb (which answers to the bones of the *Metacarpium* that sustain the fingers;) the other becoming membranous, cleaveth fast to its second and third bone.

Two bend-
ers.

1.

2.

It is bended also by two Muscles; one of which springing from the upper part of the *radius*, is implanted into the first and second joint of the Thumb; the other being less, proceeds from that bone of the *carpus* which sustains the Thumb; lying under the other, and reacheth to the middle of the Thumb. These two are all the Benders acknowledged by *Bartholin*, *Diemerbroeck*, &c. but *Spigelius*, de hum. corp. fabric. l. 4. c. 19. describes two which bend the first joint, four the second,

second, and one the third. Those two which bend the first joint, together with the *Abducens* of the same, he says, make the *monticulus pollicis* or ball of the Thumb, or as Chiromancers call it *monticulus Lunæ*.

Monticulus lunæ.

It is moved laterally by two Muscles. The first is called *Thenar* (by *Riolanus*) or *Abducens*. This springeth from the inner part of that bone of the Wrist, which stayeth the Thumb, by a nervous beginning: then becoming fleshy, it is inserted into the first joint of the Thumb by a membranous Tendon, and draweth it from the fore-finger. Some make three of it.

Movers laterally, two.

I.

The second is *Antithenar*, or *Adducens*, which lieth in the space between the Thumb and Fore-finger. This doth arise from the outside of that bone of the *metacarpium* which sustaineth the fore-finger; and being fleshy is inserted into the whole inner side of the first joint of the Thumb, and sendeth a membranous Tendon to the second. This draweth the Thumb to the Fore-finger. Some describe a second *Adducens* arising from the inner side of the bone of the Wrist that sustaineth the Thumb, and ending in its second joint.

2.

Authors differ very much as to the number, rise and insertion of these Muscles of the Thumb, which is occasioned partly by their smalness, and partly from their crossing and being entangled one with another, so that 'tis very difficult to trace and raise them.

CHAP.

C H A P. XXVIII.

Of the Muscles of the Thigh.

THE Thigh has four manner of motions: it is either bended (and that forwards, or backwards) or drawn inward, or outward, or moved round.

Two benders forwards of the thigh.

I.

It is bended forward by two Muscles. The first is called *Psoas*, or *Lumbaris*: this lieth in the inner part of the *Abdomen*, upon the *vertebrae* of the *Loins*, &c. It ariseth fleshy from the side of the bodies and from the transverse processes of the two lowermost *vertebrae* of the *Thorax*, and two or three uppermost of the *Loins*, from whence descending by the inside of *os ilium*, when it is come to the *os pubis*, it turns into a round and strong Tendon, which is inserted into the lesser *rotator* of the Thigh-bone.

2.

The second is *iliacus internus*: This springeth with a slender and fleshy beginning from the inner cavity of *os ilium*, and being joined to the *psoas* by its Tendon, it endeth before between the greater and lesser *rotator*.

Three benders backward.

I.

It is bended backward or extended by the three *Glutaei*, which make up the Buttocks, and serve to go backward withall, or else to raise the Body up streight after sitting. The first which is the greatest, and lieth outmost, is called *glutaeus major*. It springeth very carnosus from the *coccyx*, from the spine of *os sacrum*, and from all the circumference of the *costa* or edge of *os ilium*, and is inserted by a strong Tendon four inches below the great *rotator*.

The

The *second* lies in the middle, whence it is called *gluteus medius*. It springeth from the fore-part of the *costa* and back of *os ilium* a little lower than the former, and is inserted into the outer and upper part of the great *rotator*.

2.

The *third* lies undermost, and is called *gluteus minor*. It springeth a little lower than the former, (from the outer or backside of *os ilium*) lying wholly under it, and is implanted into the upper and inner part of the great *rotator* by a broad and strong tendon.

3.

It is drawn to the inside by the *musculus triceps*. This is the thickest of all the Muscles of the Body, and might more justly be called *quadriceps*, seeing it has four beginnings; but they that imposed the name of *triceps*, made a particular Muscle of the first of its four Heads, and called it *pectineus*, or *livoidus*. The *first* head doth proceed nervous from the upper part of the *os pubis*, and is inserted into the rough line of the thigh bone. The *second* springing from the lower side of the same bone, being lesser, is inserted a little higher up in the said line. The *third* arising from the whole lower part of the *os ischii*, is inserted a little under the lesser *rotator*. The *fourth* springing from the apex or tip of the *os ischii* is implanted into the inner and lower tubercle of the Thigh by a round Tendon, which is joined with the slender Tendon of the first part of this Muscle.

One drawn
or to the
inside.

It is turned towards the outside by four small Muscles called *Quadrigemi*. They are placed behind upon the articulation of the Thigh, one by another. The *first* is called from its situation *Iliacus externus*, and from its figure *pyriformis*; it is longer than the rest, and ariseth from the outside of the three lowest *vertebrae* of *os sacrum*.

Four turn-
ers to-
wards the
outside.

1.

The

2. The *second* ariseth from the knob of *os ischium*.
3. The *third* ariseth from the same part. These three are inserted into that dent that is in the top of the great *rotator*, or as *Bartholin* says, into that space that is betwixt the two *Rotators*. The
4. *fourth* is called *Quadrigenus quadratus*, and is more fleshy and broad than the rest : it lieth two inches distant from the third, arising from the inside of the knob of the *ischium*, and is implanted into the outside of the great *rotator*.

Two turn-
ers about
obliquely.

I.

It is turned about obliquely by two Muscles called *Obturatores*. The first is *obturator internus*, this turneth it outward. It ariseth from the inner circumference of the hole that is between the *ischium* and *os pubis*, from whence passing transversly outwards over the *coxendix*, it is inserted into the aforesaid dent or cavity of the great *rotator*.

2.

The *second* is *obturator externus* : this ariseth from the outer circumference of the said hole, and turning about the neck of the thigh-bone, as about a pulley, it endeth in the said cavity of the great *rotator*, and turneth the Thigh inward.

Note, that though for orders sake we have describ'd the Muscles of the Thigh before those of the Leg, yet the Dissector cannot so easily nor conveniently raise and shew them, till those of the Leg are first raised and removed.

C H A P.

C H A P. XXIX.

Of the Muscles of the Leg.

THE Leg is made up of two bones as well as the Cubit, viz. *tibia* and *fibula*; but Anatomists have not distinguish'd their Muscles like those of the *ulna* and *radius*, but call them all, *the Muscles of the tibia or Leg*. Five benders of the Leg.

Now the Leg is either bended, extended, or moved obliquely.

There are five that bend it. The first is *Longissimus*. This ariseth from the inner knob of *os Ilium*, and descends ourermost just under the skin on the inside of the Thigh, running obliquely over the other Muscles, and a little above the Knee ending in a Tendon, which is inserted under the Knee, into the fore and inner side of the *tibia*. It is otherwise called *fascialis*, because it embraces the Muscles that lie upon the Thigh like a *swadling-band*.

The second is called *Gracilis*, and springeth with a nervous and broad beginning at the joynting of the *os pubis*; from whence it runs down the inside of the Thigh, and is implanted by a round Tendon into the inner side of the *tibia*, near the insertion of the first, but a little lower.

The third is named *seminervosus*, because it is half nervous and half fleshy; for it arises nervous from the knob of the *Ischium*, and so continues till its middle where it becomes fleshy, descending on the backside of the thigh; and when it is come near the ham, it turns into a round tendon, which is inserted into the inner side of the *tibia*, towards

the backside, running as far as its middle.

4. The *fourth* is called *semimembranosus*, because it is *half membranous*. It proceedeth from the same knob, partly nervous, and partly membranous; and endeth by a broader Tendon than the third in the hinder part of the *tibia*.

5. The *fifth* is called *biceps*, because it seems to have *two heads*: for first it ariseth from the same knob of the *ischium* nervous; and from thence being carried on the outside of the Thigh, about its middle it becometh fleshy, as if it begun there with a second head; from whence descending it is inserted by a notable Tendon into the outer side of the upper appendix of the *fibula*.

Five extenders.

1. The Leg is extended also by *five* Muscles. The *first* is *membranosus*: this proceeding fleshy from the upper part of the spine of *os ilium*, on the outside of the Thigh-bone near the great process or *rotator* turns into a broad membranous tendon, wherefore it is called *fascia lata*, for it covereth almost all the Muscles of the Thigh and *tibia*, and at last is inserted a little below the Knee, into the outer and foreside of the *tibia* and *fibula*.

2. The *second* is *Rectus*: this springing from the lower part of the spine of *os ilium*, and passing with a carnos and round belly straight down the Thigh before, when it is come to the *patella*, it ends in a broad and strong Tendon, by which it adheres close to the *patella*, as if it would end in it; but it passes further, and is inserted into the foreside of the *tibia* a little below the Knee.

3. The *third* is named *vastus externus*: this springeth from the root of the greater *rotator*, and descending along the outer and foreside of the thigh endeth a little below the *patella*, near the same place with the former.

The

Chap. XXIX. Of the Muscles of the Leg.

515

4

The fourth is called *Vastus internus*: this ariseth from the root of the lesser *rotator*, and descending on the inner and fore-side of the thigh endeth a little below the *patella* with the other. The *Vastus externus* descends on the outside of the *rectus*, and the *internus* on the inside thereof, whence they have their name.

To these some add a fifth Muscle called *Crureus*, which springeth from the fore-part of the Thigh-bone, between the two *rotators*, and adhering close thereto in its descent, endeth in the same place with the former.

5.

Note, that these four last Muscles being joined together about the Knee, make one common broad and strong Tendon, by which they involve the *patella* or Knee-pan, and which being inserted into the *Tibia*, tyes it and the Thigh-bone together like a strong ligament. Note also, that the Muscles which extend the Leg are stronger than those which bend it, that the weight of the Body may be the more firmly upholden when we stand.

There is also a single Muscle called *popliteus*, One mover or *subpopliteus*, which moveth the Leg obliquely: obliquely. this lyeth in the hollow of the ham, and springeth from the outer knob at the lower end of the Thigh-bone, and is carried obliquely to the hinder and inner side of the appendix at the upper end of the *tibia*.

L12

CHAP.

CHAP. XXX.

Of the Muscles of the Foot or Tarsus.

THE Foot is moved according to the motion of the *Tarsus* or *Wrist*, (or as some call it the *Instep*, though that name is more proper to the *Metatarsus* or upper arched part of the Foot.) Wherefore the Muscles that perform these motions, are indifferently called the Muscles of the Foot or *Tarsus*.

Two bend-
ers of the
Foot.

I.

The Foot then is either bended, extended or moved sideways, according to the motion of the *Tarsus*. It is bended when it is drawn forwards or upwards. To perform which motion it hath two Muscles. The first is *Tibialis anticus*: this ariseth from the upper appendices of the *tibia* and *fibula*, and cleaving unto the whole *os tibia*, about the middle of it it becometh narrower, and turneth by degrees into a Tendon, which passing under the annular ligament of the *Tarsus* or *Wrist* that springs from the lower appendices of the *tibia* and *fibula*, is commonly divided into two; whereof the one is inserted into the first of those bones which are called *innominata*, and the other into that bone of the *metatarsus* or *Instep* that is set before the great Toe. If the Tendon continue one, then it is implanted into the inner side of this last Bone.

2.

The second is *Peronæus anticus*: this ariseth from the outer and upper part of the *perone* or *fibula*, and being carried through the fissure of the outer ankle, it is inserted into that bone of the *Metatarsus* which sustaineth the little Toe. It descends

descends all along by the outside of the foregoing Muscle, and hath sometimes two Tendons.

The Foot is extended when it is drawn downwards or backwards. To perform which motion it hath three Muscles. *Three extensors.*

The first is called *Gemellus externus*, being reckoned by some for two; also *Gastrocnemius externus*, because it with the following maketh the calf of the Leg, which in Greek is called *Gastrocnemia*. It hath two heads, the first of which arises in the ham, from the inner head of the thigh-bone, fleshy and broad; from whence it marcheth down by the back and inner part of the tibia, and when it is come to the middle of it, becometh tendinous. The other head likewise ariseth in the ham, but from the outer head or prominence of the Thigh-bone, and passing down by the outward and back part of the Leg, becometh tendinous a little above the former, and joyning with it they both grow into one strong, broad, and nervous Tendon, which is inserted into the hinder side of the Heel.

The second is called *Gemellus internus*, or *Gastrocnemius internus*, because it lyeth under the former; and lastly *Soleus*, from its resembling the Sole-fish in shape. It is of a livid colour, springing from the backside of the upper appendix of the fibula by a strong nervous beginning, and growing pretty bulky it continueth so till it hath passed the middle of the tibia, when it becometh narrower, and tendinous; and a little above the Heel it is sounited to the Tendon of the former *Gemellus*, that both seem to turn into one, which is inserted into the Heel.

The third is *Plantaris*. This springeth from the outer head of the Thigh-bone in the ham,

very small but carnosus; from whence it descends but a little way before it ends in a very long and slender Tendon, which joyning very closely with those of the two former is fastened to the Heel, but reaches as far as the middle of the soal of the Foot; (*Spigelius* says, as far as the Toes, and is inserted into the first joynt of each of them, imitating the *palmaris* of the hand.) The three Tendons of these three Muscles thus uniting make one most strong and thick Tendon, usually called the *great cord*; and this being implanted into the Heel makes a wound there so very dangerous.

Two movers sideways.

1.

The Foot is moved sideways by two. The first is called *Tibialis posticus, adducens pedem*, or *Nauticus*, because Sailors use it much when they climb up the Mast. It springeth both from the *tibia* and *fibula*, and from the Ligament which tyeth them together; whence descending among the hinder Muscles, near to the inner Ankle it becometh tendinous: then passing by it, it goeth to the soal of the Foot, and is inserted into the under side of that Bone of the *carsus* which is next to the *cubiforme*, viz. the third *cuneiforme*. This moveth the Foot inwards.

2.

The second is called *Peronæus* or *fibularis posticus*: this ariseth from the upper and hinder part of the *fibula* or *perone*, by a nervous and strong beginning; and in its descent becoming fleshy and round, it cleaves to the outside of the *fibula*, having its outer part of a livid colour, but the inner of a red. When it is come to the middle of the *fibula* it becometh tendinous, and descends with the *Peronæus anticus* by the fissure of the outer Ankle, but joins not with its tendons, for it goes under the soal of the Foot, and is inserted into the

the root of the first or greatest of the three *ossa cuneiformia*, that is seated before the great Toe.

Sometimes, though seldom, there is another Muscle, called *Peronæus tertius*, which being very slender accompanies the *posticus* in its whole progress, and is inserted into the same place, assisting its Action, which is, to bend the Foot outwards.

C H A P. XXXI.

Of the Muscles of the Toes.

THE great Toe is moved by its proper Muscles, as the Thumb of the Hand was: but the other four, by *common*, which we will first describe.

They are either extended, bended or moved obliquely.

The Extenders are *two*. The first is *tensor longus*. This ariseth by a nervous and acute beginning from the fore and inside of the upper appendix of the *tibia*, and presently becoming carnosus, it goeth streight down along the *fibula*, and being come to the *tarsum* it is divided into four Tendons, which passing under the annular or transverse Ligament thereof, go each to one of the four lesser Toes, and are inserted into their second and third joint on the upper side. As they run along the backside of the Foot they are tyed one to another by a membranous ligament, for the strengthening of them.

Two extenders of the four Toes.

1.

The second is *tensor brevis*. This lyeth under

2.

L 1 4

the

the former, having its beginning from the transverse or annular Ligament of the *tarſus*, fleshy and broad, and by its four Tendons is inserted into the first joints of the four Toes; (*Spigelius* says, into the second.)

Six benders.

1.

The benders of the four Toes are in like manner two, and four *Lumbricales*. The first is *flexor longus*, or *perforans*: it lyeth under the *gemellus internus*, and ariseth from the upper and hinder part of the *tibia* by a long and fleshy beginning; and passing down along the *Tibia*, (unto which it cleaveth) when it is past the middle of it, it becometh tendinous: then running by the inner Ankle, under the Ligament of the *tibia* and Heel, to the soal of the Foot, it is there divided into four Tendons, which passing through the holes of the *flexor brevis*, are inserted into the third or last joint of the four Toes.

2.

The second is *flexor brevis*, or *perforatus*: this springeth from the under and inner side of the Heel-bone, and when it hath passed the middle of the Foot, it is parted into four round Tendons, which are inserted into the second joint of the four Toes, being perforated to give way to the Tendons of the former Muscle to pass to the third joint.

Four Lumbricales.

They are also bended by four *Lumbricales*, which agree altogether with the *Lumbricales* of the hand both in their use, figure and rise. These spring from the Tendons of the two former small and round, (or rather from the membranous Ligament that incloses them) and are inserted by a small Tendon into the side of the first joint, which they help to bend. The fleshy substance, which riseth with two acute beginnings from the fore part of the lower side of the Heel-bone, and reacheth

reacheth to the rise of these Muscles, seemeth much to further their Action, and to afford them their carnous substance.

The Toes are moved obliquely by the *Interossei*, which are so called, because they are placed between the bones of the *Metatarsus*. They are ten in number, whereas there are but eight in the back of the Hand, because the *Metatarsus* hath one bone more than the *Metacarpus*, there being one to sustain the great Toe as well as the rest, whereas the Thumb hath none. Each of them doth spring from the under side of that bone upon which it is placed, but presently turning to its side, it keeps its course along the interstice of the bones till it arrive at the first joint of the Toe, into the side whereof it is inserted by a short and somewhat broad Tendon. If the inner be contracted, the Toe is moved inwards; if the outer, outwards. But if they both act together, then are the Toes extended. In the four distances between the bones, there are eight such Muscles; at the outside of the great Toe one, and another at the outside of the little Toe. But, besides it, the little Toe hath a proper *Abductor* to move it outwards, which arising from the Heel passes on the outside of the fifth bone of the *Metatarsus*, and is inserted into the outside of the first joint or bone of this toe.

Ten more obliquely.

The great Toe hath five peculiar or proper Muscles. The first is *Extensor*: this springeth by a tender of fleshy beginning from the outside of the *Tibia*, where the *fibula* stands out from it: after a short space it passeth into a tendon, which running under the annular ligament of the *tarsus*, and marching along the upper part of the Foot, is inserted into

One extends the Pollex or Great toe.

into the whole upper part of the great Toe, which it extends.

One ben-
der.

The *second* is *Flexor*: this springeth from the upper and back part of the *Fibula*, and descending by the side of the *Flexor longus* to the inner Ankle, it there becometh tendinous, and running with the *longus* under that ligament there which tyeth the lower *appendix* of the *tibia* to the heel, it is inserted into the third or last bone of the great Toe, by one strong Tendon, serving to bend it. But sometimes it is divided into two Tendons, whereof one is inserted as above said, and the other into the second Toe: and when this happens, the *Flexor longus* sends but three Tendons to the three last Toes, and none to the second.

Three mo-
vers side-
ways.

1.

The *three* following move it sideways: of which the *first* is called *Abducens pollicem*, because it draweth the great Toe from the rest, toward the inside of the Foot. It springeth nervous from the Ligament which tieth together the Heel bone and the *Talus* (or according to some, from the inner side of the Heel it self) and running forwards on the inside of the Foot, it is inserted by a round Tendon into the outside of the first joint of the great Toe.

2.

The *second* is called *Adducens pollicem major*, drawing the great Toe towards the rest. This springeth from the Ligament that ties those two bones of the *Metatarsus* together which sustain the little Toe and the next to it, and proceeding obliquely over the other bones it is implanted into the inner side of the first joint of the great Toe.

3.

The *third* is called *Adducens pollicem minor* (and otherwise *Transversalis* from its running across the foot.)

foot.) This ariseth from the Ligament that binds the first joint of the little Toe, and passing cross the first bones of the other Toes it ends in the inside of the first bone of the great Toe. Some think this serves onely to tie together the first bones of the Toes (like a Ligament :) But *Casseri-
us* (who first found it out) says it draws the great Toe to the little one, and so makes the Foot hollow, grasping the ground as it were, when we go in stony and uneven places, to fix the Foot more firmly.

The end of the Fifth Book.

(Foot). This arises from the Ligament that binds the first joint of the little Toe, and passing cross the first bone of the other Toe it ends in the middle of the first bone of the great Toe. Some think this serves only to tie together the first bones of the Toe (like a Ligament). But Cassius (who first found it out) says it draws the great Toe to the little one, and so makes the Foot hold low, grasping the ground as it were, when we go in rocky and uneven places, so in the Foot more firmly.

The end of the Fifth Book

The Sixth Book.

B O N E S.

CHAP. I.

Of Bones in general.

A Bone is called in Greek *ὀστέον*, from *ὀσμή*, to Bones, stand; for according to Hippocrates, *ὀστέον* is *ὀσμή*, *ὀσμή* is *ὀσμή*, *ὀσμή* is *ὀσμή*, name. it affords stability, straightness and form to the Body.

It may be defined to be a similar part, most dry, cold and hard, inflexible, void of sense, affording stability and form to the whole body.

Bones have been commonly taught to be made of the more crass, tartareous or earthy part of the Seed, in the Womb, and that they are nourished with the like particles of the Blood, and moisten'd with their contained Marrow. And I see no reason to recede from this doctrine, unless one would commence *littem de nomine*, brangle about a term: for though Women have no true Seed, and the Man's being onely an active principle of generation affords nothing of matter to the parts of the *Fetus*, but onely impregnates the *Ovum*,

Ovum; (as was shewn in B. I.) yet if we will but grant the name of *Seed* to the humour in the *Ovum*, (which we may do without absurdity) we may continue the old manner of speaking. Now though they are continually nourished, yet towards Manhood, by the increased heat of the Body, the primigeneal moisture is so lessened, that the bones through their hardness are not apt to be any longer extended; and so Men cease to grow any higher of stature.

Vessels.

Their nourishment is brought to them by the *Arteries*, and what is not fit for their use returns back by the *Veins*. Several of them, as the Shoulder and Thigh-bones, have apparent holes for the entrance of the vessels in to their Marrow: and such as have no Marrow, and so want such holes, they are commonly of a more spongie or fungous substance, into which no doubt some nutritive particles of the Blood pass from the Arteries, though their branchings therein are not so apparent. There are no Nerves that are inserted into them (except into the Teeth) but these onely run through the Membrane or *Periosteum* that invests them.

*Efficient
and form-
mal causes.*

The efficient cause of the Bones is the same vivifick spirit or plastick power seated in the *Ovum*, that forms all the other parts of the Body; *Galen* calls it *Fatidum* *Primum*, the officick faculty: some think this same spirit might be called the essential form of the Bones; though commonly that is said to be their cold and dry temperature; as their accidental form is their figure, which is commonly either round or flat. But these are too dry notions to be insisted on in this place.

Substance.

Their substance is whitish and hard, (in some Bones, and at some ages, more, and in others less)

less) not altogether dry in living persons, but bedewed with a fat and unctuous moisture, which the more it abounds, the Bones are the tougher and less apt to break; and when they are broken, they are the apter to grow together again with a *Callus*, which such viscous juice contributes very much to. And it is onely by a *Callus* that any Bone is joined after fracture; for a Bone being of the number of those parts that are called *spermatick*, can never be generated anew.

Some bones, as that of the Thigh, the Shoulder-bone, &c. are hollow within like a pipe, and have their Cavity filled with marrow; others have no such cavity, but onely small and obscure pores or caverns fill'd with a bloudy and marrowy juice for their nourishment, as the Ribs, Skull, &c. a third sort are more solid than these, having no perceptible cavities or pores, as the little bones of the Wrist, and yet reason concludeth that these also are not destitute of all pores though the eye cannot discover them, for if they were they could not be increas'd and nourish'd.

Besides the hollowneses or caverns in the inside or substance of bones, some have cavities or *sinus*'s on their surface or outside; which if it be small and shallow, as in the Knee, is called *Glene*; but if wide and deep, as in the Hip-bone where it receives the Head of the Thigh-bone, *Cavyle*; and the edges or brims of such cavity are called *labra* or *supercilia*.

Besides these cavities there are considerable in the outside of Bones their *Prominences* or *Prouberances*, of which there be two kinds: for it is either a continued part of the Bone jetting manifestly above its plain superficies, for the more commodious insertion of the Muscles, &c. and is called *Prominences*, viz.

Apophy-
sis, or

Epiphysis.

called *Apophysis*, a *Process*; or else it is like an additional Bone growing to another by simple and immediate contiguity, (and generally softer and more porous than it) and is called *Epiphysis*, an *Appendage*. If the Protuberance of the Bone be round, it is called its *Caput*; under which is the *Cervix*, as in the upper end of the Thigh-bone: If it be flat, it is called *Condylus*: if sharp, *Corone*. Other Protuberances or processes are named from the similitude they have to other things, as *Sylloides*, *Coracoides*, &c.

Use.

Their *uses* are many: for they serve 1. for the firmitude and sustentation of the body, like beams and pillars in houses: 2. for a defence to some parts; so the Skull defends the Brain, the Ribs the parts contained in the Breast: 3. for progression or walking, of which they with the Muscles are the onely instruments: 4. they give shape to the parts of the body. These are their *general* uses; as to their *particular* uses, those will be shewn as we describe them severally.

CHAP. II.

Of the different conjunctions of Bones one to another.

Bones are joined to one another either by *Articulation* or jointing; or else by *Symphysis* or growing together.

Articula-
tion.

Articulation is either for manifest, or obscure motion. The former is called *Diarthrosis*; because the articulation is loose; the latter *Synarthrosis*,

throffis, because it is close and compact.

Diarthroffis, or that jointing which serves for 1. *Diarthroffis*.
manifest motion, is threefold. First, *Enarthroffis*,
which is when a large head of a Bone is received
into a deep Cavity, as the Thigh-bone into the
Hip-bone. Secondly, *Artbrodia*, which is when
the Cavity which receiveth is shallow, and the
head of the Bone which is received, flattish: such
is the articulation of the *Radius* with the Shoulder-
bone, or of the Shoulder-bone with the *Scapula*.
The third is *Ginglymos*; when the same Bone re-
ceiveth, and is received. This falleth out three
manner of ways. First, when the Bone is received
by another, and receiveth the same; this is seen
in the articulation of the Shoulder-bone with the
Ulna. Secondly, when a Bone receiveth one
Bone, and is received by another: which is done
in the Spondyls or *Vertebrae* of the Back, where
the middle Bone receiveth the upper, and is re-
ceived by the lower. The third is, when the
process of the Bone being long and round, is in-
serted into another upper Bone, and so is turned
in the Cavity like an Axle-tree in a Wheel; so
is the second *vertebra* of the Neck jointed with the
first.

Synarthroffis or Articulation for obscure motion is 2. *Synarthroffis*.
such as that of the Ribs with the *Vertebrae*, &c.

Bones grow together either without some middle *Symphysis*.
heterogeneous substance, or with it. Without some
middle substance they are joined three manner of
ways. First, by a simple line, as the Bones of
the upper Jaw and Nose: this is called *Harmonia*.
Secondly, by a suture, (or *Rhaphe*) as the Bones
of the Skull. Thirdly, when one Bone is fasten-
ed in another, as a nail in wood; and so are the
M m Teeth

Teeth fastened in the Jaw-bone: this is called *Gomphosis*.

If Bones grow together by a middle substance, it is either by a *Cartilage*, as the Share-bones are joined; which union is called *Synchondrosis*: or by a *Ligament*, and so the Thigh is joined with the Hip-bone; this is called *Synneurosis*, or more properly, according to *Spigelius*, *Syndesmosis*: or last of all by *Flesh*, and so is the Bone of the Tongue by its Muscles to the adjacent parts; this is termed *Syssarcosis*.

Spigelius reckons two other heterogeneous middle substances by which Bones are united; one when they are joined by a *Tendon*, as the Kneepan to the Thigh-bone and *Tibia*, which union he calls *Syntenosis*; the other by a *Membrane*, as in Infants the Bones of the *Synsippius* with the *O: frontis*; and this he calls *Synymenosis*.

CHAP. III.

Of the Skull in general.

WHEN all the Bones of the Body are artificially joined to one another and seated in their proper places, the whole structure of them is called a *Skeleton*, from *σκληρον*, to dry, because they are then void of all moisture.

This *Skeleton* is commonly divided into the *Head*, *Trunk* and *Limbs*.

The *Head* is again divided into the *Skull* or *Scalp*; and the *Face*.

The Skull
is name.

The Skull is called in Greek *κεφαλον*, *Cranium*, because

because it defends the Brain *tanquam xlviii*, like an helmet; and in Latine *Calvaria*, *qu. calva capitis arx*, because it comprehends all that part of the head upon which the hair grows, and which is said to be *bald* when the hair falls off.

Its figure is globous or round, but not exactly, Figure. for it bunches out a little before and behind, and is more flat on the sides, so that it is somewhat longish. The more it varies in any particular persons from this shape, the more preternatural is its figure. Some raise a nice question concerning its shape, whether it be owing to that of the brain included within it, or whether the shape of the brain be owing to this of the Skull. 'Tis true, that they answer one to the other in figure, but whose is owing to the others is needless to enquire; nor shall we spend time in such a fancifull dispute.

In an Embryo its *substance* is membranous, in Substance. infants new born 'tis bony, but softish and flexible; but it grows harder and harder by degrees (like the other bones) yet continues spongie in its middle.

It consists of two *lamine*, plates or tables (so called) the outer thicker and smoother, but the inner harder and furrowed on its inner superficies, to give convenient and safe passage to the vessels that creep through the *dura mater*: yea in some places it is perforated for the transit of vessels from the said *meninx* to betwixt the *lamine* for the irrigating of the pith that lies between them.

Which pith is called *Diploe*, and is a spongie Diploe. and cavernous substance containing a medullar and somewhat bloody juice for the nourishment of the Skull. It is more porous in young bodies than in old; and in some places of the skull than

in others : for in some the two tables grow so close together that 'tis hardly discernible.

Diemerbroeck writes that he has sometimes observed (especially in Venereal persons) a virious humour collected in this spongie pith, which in tract of time becoming more acrimonious and virulent, has eat through the very tables, especially the outer which is softer, and caused most tormenting pains in the *periosteum* and *pericranium*; yea sometimes the inner also, and so the whole Skull has been perforated.

CHAP. IV.

Of the sutures of the Skull.

BEfore we come to describe particularly the Bones which the Skull consists of, we will treat in short of their several manners of commixture or connexion one with another, or with those that are contiguous to them, *viz.* the upper Jaw and the three bones that are common to the Skull and upper Jaw, *viz.* the *jugale*, *cuneiforme* and *spongiosum*, or lastly, of these common bones with those next to them.

Sutures Their connexions among themselves and also
are proper with these other bones, are both called *Sutures*
or common (or seams :) and these are divided into proper, or
common.

Proper sutures true, The proper are those which join the Bones of
the Skull one with another; and are either (*vera*) true *Sutures*, or (*mendosæ*) counterfeit.

Three true. The true are when two bones being mutually indented,

indented, close one with the other; as if two Saws were joined together by their Teeth; whence they are called *serratae*: and these are three in number: the first is *Coronalis*, which is seated in the fore part, and passeth from one Temple to the other transversely, joining the *Os frontis* to the *Synceput*. The second is *Lambdoides*, opposite to this, resembling the Greek letter Λ *lambda*. This beginning at the basis of the *Occiput* ascends obliquely to either Ear, and joins the Bone of the *Occiput* to the Bones of the *Synceput* and Temples. The third is *Sagittalis*, which beginning at the top of the *Lambdoides*, comes straight forward by the Crown to the middle of the *Coronalis*, and in Children for some years (sometimes in the adult) it runs to the top of the Nose, dividing the bone of the Forehead into two. *Spigelius* notes that these true Sutures are only in the outer *lamina*, the inner being joined only by *harmonia*.

The counterfeit or *mendosa* resemble a line only, and are more properly called *Harmoniae* than Sutures. *Spigelius* reckons five of them, others more, but the chief of them are but two. The first passing from the root of the *Processus mammillaris* upwards, with a circular duct circumscribes the Temple-bone, and descends down again to the basis of the Ear: this suture joins the Bones of the *Synceput*, *Occiput* and *Sphenoides* with the Temple-bone, this lying upon those like the Scales upon Fish, whence this Suture is called *Squamosa*. The second runs from the top of this squamous conjunction obliquely downwards towards the orbit of the Eye, to the beginning of the first common Suture, and joins this Bone above with the Bones of the

Two counterfeit.

Sinciput, and below with the Bone of the Fore-head.

Common
Sutures.

The *common* Sutures are those whereby the bones of the Skull (as also the common bones) are joined to those which are contiguous to them. And of these by *Diemerbroeck* there are reckoned five. The *first* is that by which the outer process of the *Os frontis* is joined with the first Bone of the upper Jaw. The *second* is seated in the outer and lower part of the orbit of the Eye. The *third* ascends obliquely from the inside of the orbit to the top of the nose. The *fourth* proceeds obliquely by the middle of *os jugale*, joining it (or rather the first bone of the upper jaw) to the temple-bone. The *fifth*, below in the cavity of the nostrils, tends from behind forwards: *Spigelius* says, this is common to the *os cuneiforme* with the *septum* of the Nose.

The uses of
the su-
tures.

• The Sutures have three uses. The *first* is to help to stay the Brain from shogging, and its parts from being misplaced in violent motions, by permitting some Fibres to pass through from the *Dura mater* to the *Pericranium*, (or from this to that) by which the said *Mater* and the Brain invested in it are suspended as it were. The *second* is to permit the vapours and fumes of the Brain to evaporate. And the *third*, to hinder the fissures that happen in the Skull from knocks or falls, &c. from extending any farther than through one Bone, for they generally stop at the next Suture.

CHAP. V.

Of the proper Bones of the Skull.

THE Bones proper to the Skull are in number *Six proper bones of the Skull.* *six*, one of the Forehead, another of the Occiput, two of the Crown, and two of the Temples.

First, *Os frontis*, the Forehead bone. It is bounded by the Coronal and first common Suture, before; and in the sides by the temporal Bones. It is but one in those of ripe age, but double in Children, being divided by a Suture passing down its middle from the Coronal to the Nose. *1. Os frontis.*

Betwixt the *Lamina* of this bone at the top of the Nose, there is a large Cavity or cavern, (often two) from whence two holes pass to the Nostrils. The outer *Lamina* that constitutes this Cavity, makes the upper plane part of the orbit of the Eye; but the inner, on each side above the Eyes forms a buncy protuberance uneven with many jettings out like little Hills. The Cavity is invested with a very thin greenish Membrane, and contains a clammy humour. What its use may be is hard to say; some think it gives an Echo to the Voice, making it more sonorous; others that it receiveth the odoriferous air drawn in by the Nose, to stay it awhile before it be sent to the Brain. But these seem but vain conjectures. *Its cavity.*

It hath two holes in the middle part of the Eyebrow, which come from the orbit of the Eye, by

which the first branch of the Nerve of the fifth conjugation of the Brain goes to the Muscles of the Forehead, &c.

Processes.

It hath also four *processes*; the greater two are seated at the greater corner of the Eye, and the lesser two at the lesser, making the upper part of the orbit.

2, 3. Two bones of the Synciput.

The Bones of the *Synciput* or Crown are in number two. Before, they are joined with the Bone of the Forehead by the Coronal suture; behind, with the *Os occipitis*, by the *Lambdoides*; on each side to the Temple-bones, by the *Sutura squamosa*; and to one another in the middle of the Crown, by the sagittal Suture. On the outside they are smooth; but on the inside uneven, for they have a great many furrows running along their inner *superficies* for the passage of the Veins of the *Dura mater*. Their substance is thinner and more rare even in the adult than that of the other Bones (for the better exhalation of vapours) but in Infants that abound with much humidity, they are membranous and soft, hardening by degrees.

4, 5. Two Temple-bones.

Below these on each side are the Bones of the *Temples*. They are joined in their upper part to the outside of the Bones of the *Synciput* by the *Sutura squamosa*; before, to the process of the first Bone of the upper Jaw; behind, to the *Os occipitis*, by a counterfeit Suture. These Bones are even and thin in their upper part, like a Skale, (and consist but of one *lamina*) but below thick, hard and unequal or craggy; wherefore they are called *Petrosa*.

Each has two sinus.

They have each two *Sinus*; the outer greater, lined with a Cartilage, betwixt the *Meatus auditorius* and the process that makes part of the *Os jugale*;

Chap. V. Of the proper Bones of the Skull.

537

jugale, this receives the longer process of the lower Jaw: the inner less, common to it with the Bone of the Occiput, placed on the hinder side of the first named process.

By these Sinus there stands a slender, sharp and longish Appendix, from its shape called *Styloides*, which in Infants is cartilaginous, but in the adult becomes bony. One Appendix, viz. Styloides.

Besides this Appendix they have three Processes, Three processes, two external and one internal.

The first external is blunt, thick and short, a little hollow within, and because it somewhat resembles a Cow's Pap, is called *Mammillaris*. 1. Processus mammillaris.

The second is carried forward from the Meatus of the Ear, and is joined with the first Bone of the upper Jaw, both of them framing the *Oss. jugale*, of which in the next Chapter. 2.

The third, that is internal, is called *processus petrosus*, and *os petrosum*, from its hardness and cragginess. It is pretty long, jutting out to the inner basis of the Skull, within which it has two holes, through one of which an Artery, and through the other the auditory Nerve pass to the inner Cavities of the Ear, that are excavated in this process, namely the *Tympanum*, *Labyrinthus* and *Cochlea*; and without the Skull it hath three holes; the first of which is the *Meatus auditorius*; the second is narrow, short and oblique, near to the first, by which the Jugular vein enters the inner Cavities; the third is seated betwixt the *Processus mammillaris* and the *Styloides appendix*, and ends into that passage that goes from the Ear to the Mouth. 3. Petrosus.

As to the four little Bones that are contained in its first inner cavity called *tympanum*, viz. *Incus*, *Malleus*, *Stapes*, and *Os orbiculare*, we have

6. *Os occipitis.*

have spoken of them before in Book 3. Chap. 23. The *Os occipitis*, that makes the hinder and lower part of the Head, is five-corner'd, by two of which corners it is joined in its upper part to the Bones of the *Synsippus* by the *Lambdoides* Suture, by two other in its foresides to the Temple-bones by a counterfeit or squamous Suture, and by its fifth corner to the *Os cuneiforme*. It is but one in the adult, but it consists of four or more in Infants. It is the thickest and most compact of all the Bones of the Skull.

Its sinus.

It is said to have nine *Sinus*, two external, and seven internal. The external are one on each side of its great hole behind by which the spinal marrow descends. Of the internal the two largest are those that receive the protuberances of the *Cerebellum*.

Processes.

It has also five *Protuberances* or *processes*, four of which are by the sides of the great *foramen* aforesaid, and being all covered with a cartilage are received into the *Sinus*s of the first *vertebra*, serving for the articulation of the head: the fifth is larger than these, ascending inwards from the great *foramen*, and parting the protuberances of the cerebel.

Holes.

Lastly, it has five *Foramina*, of which the lowest and largest is that by which the *Medulla oblongata* passes out of the Skull into the *Vertebra*s. The rest are less, and are for the transit of the Vessels.

C H A P. VI.

Of the Bones common to the Skull and upper Jaw.

Hitherto of the Bones proper to the Skull: Three common bones.
1. Os cuneiforme.
Now follow those which are common to it and the upper Jaw. These are three: First, *Sphenoides* or *Cuneiforme*; the wedge-like Bone; so called, not that it is like a Wedge, but that it is seated betwixt the Bones of the Skull and the upper Jaw. Before, it is joined with the Forehead-bone; behind, to the *Os occipitis*. At the sides it doth accompany a good way the *os petrosum*. Above, it doth touch the first, fourth and sixth Bone of the upper Jaw; and below, the Bones of the Palate of the Mouth by its wing-like Processes. It is thick in the middle, but thinner at the edges, and in the adult it consists of two *Laminae* and a *Diploe*, like the other Bones proper to the Skull. In Infants it consists of three or four.

It has four external Processes, of which two, that are contiguous to the upper Jaw, are called *Pre-sphenoides*, *Aliformes* or Wing-like; and four internal also, which with the space betwixt them compose the *Sella Turcica*, upon which the *Glandula pituitaria* lieth, that receiveth the pituitous excrements falling from the Brain by the *Infundibulum*. Its processes.
Sella Turcica.

But, as we intimated from Dr. Lower in *Holae* Book 3. Chap. 5. there are no holes in this bone for the descent of those excrements upon the palate, as has been generally taught hitherto, but they are reformed by the Veins, as that learned Doctor affirms. Yet it hath sundry perforations for

for other purposes, viz. for the passage of the motory and optick Nerves of the Eye, and of other Nerves for the motion of other parts, as also of Veins and Arteries.

Sinus. It has divers *Sinus*: Outwardly or below it has one in each wing-like process, giving room to the *musculus pterygoideus* (or *pterygostaphilinus*) *internus*; (or rather to Dr. Brown's *pterygopalatinus*) Inwardly or above, it has one large one in the middle of the *fella*, that receives the *glandula pituitaria* above-mentioned and two or three small ones.

2. Os cribriforme. The second common Bone is *Os cribriforme*, because, like a Sieve, it hath many holes, by which the filaments of the olfactory Nerves or *Processus mammillares* pass into the Nostrils. It is seated in the middle *basis* of the forehead at the top of the Nostrils, and is covered with the *dura mater* which accompanies the nervous filaments aforesaid through the holes. It is joined by the Sutures called *Harmoniae* to the *Os frontis*, the second Bone of the upper Jaw, and to the *Cuneiforme*.

Its process. On its upper side in the middle it has growing upon it a kind of triangular process, like to the Comb of a Cock, which is therefore called *Crista galli*. And opposite to this in its lower side it has another that is thin and hard, dividing the Nose into two parts or Nostrils, the right and the left, and is called *Septum nasi*.

Os Spongiosa. To this *Os cribriforme*, in the cavity of the Nostrils, there adhere two other Bones called *Spongiosa*, because they are full of caverns or holes like a sponge or Pumice-stone. But most Anatomists consider them as parts of the *Os cribriforme*, confounding their names one with the other, calling this,

Os

Os spongiosum or *cribriforme* indifferently.

The third common Bone is (from its shape) called *Os jugale*, or the Yoke-bone. This indeed is not truly a distinct bone, but is made up of one process of a bone of the skull, and of another of the upper Jaw: But because it has a distinct name, and is common to the skull and upper jaw, as partaking of both, we therefore reckon it for a distinct common bone. I say, it is made up of two processes, of which the hinder is a process of the Temple-bone that is carried from the *Meatus auditorius* forwards; and the fore one is a process of the first bone of the upper Jaw, that maketh the lower side of the outer corner of the Eye, which reaching backwards meets the other, and is joined to it by an oblique Suture, and so makes the *Os jugale*.

By which description of this bone, its situation appears to be on each side of the face betwixt the *Meatus auditorius* and the first bone of the upper Jaw: and its principal use seems to be for defence of the Tendon of the Temporal Muscle, and to give rise to one of the heads of the Muscle *Mas-*
seter.

CHAP. VII.

Of the upper and lower Jaws.

THUS far of the Bones of the *Calvaria* or *Scalp*: next follow those of the *Face*, which are the *Jaw-bones* with their *Teeth*; to which we shall subjoin the *Bone of the Tongue*.

The

The Jaw-bones are two, the upper and lower.

The upper consists of 12 bones.

The Jaws are two, the upper and lower. The substance of the upper Jaw, especially on its inside, is not solid but spongy; and unequal, because it is framed of sundry Bones. They are six pair, six in each side. The first is almost triangular, seated on the lower side of the outer corner of the Eye, and by its process maketh up the best part of the *Os jugale* as was shewed in the former chapter. The second is a round, little and thin Bone in the inner corner of the Eye, having an hole in its lower part, called *foramen lachrymale*, upon which the *Glandula* or *Caruncula lachrymalis* resteth, and through which a branch of the fifth pair of Nerves passeth to the inner Membrane of the Nose. The third is thin as the former, but quadrangular. It is placed between the two former in the inner side of the orbit of the Eye. The fourth is called *Os male*, the Cheek-bone, and is the greatest and thickest. This maketh up the greatest part of the Cheek and Palate, and containeth all the upper Teeth in its caverns. It is joined above, on that side next the Nose, to the Bone of the Forehead, but below with the wedge-like Bone; before, with the second Bone of the upper Jaw, behind with the third, and last of all with its fellow. Under the Eye it has a hole for the passage of a branch of the fifth pair of Nerves that is bestowed on the Face; and another near the bottom of the Nose, by which an Artery and a Vein pass from the Palate to the Nostrils. The fifth is long, hard, and reasonable thick; it with its fellow maketh up the bony part of the Nose. It is joined with the Cartilages of the Nose below, (to which purpose it is very rough on that side) but to the internal process of the *Os frontis* above. The sixth

is broad and thin, and (with its fellow) makes the Roof of the Mouth.

Note, that the under side of the Orbit of the Eye is formed by the first, second, third and fourth of these bones of the upper Jaw, and the upper side by the *os frontis*: only the *os unciniforme* makes up a little part in the hinder side of the outer corner. *The orbit of the Eye how formed.*

The lower Jaw in those of ripe age is but one Bone, but in Children, till they are a year or two old, it consists of two, which are joined together at the Chin by *Synchondrosis*, and afterwards grow into one. This is moveable, but the upper immoveable. It resembleth in shape the Greek letter *v*. *The lower Jaw consists but of one bone.*

At each end of it there are two processes, where- of the one from a broad basis grows sharp, and is called *Corone*, going under the *os jugale*, and having the Tendon of the temporal Muscle firmly inserted into it. The other may be called *Articularis*, because it serveth for Articulation. This has a long Neck and a longish but flattish Head (or *Condylus*) that is covered with a Cartilage for its easier motion. By this Head it is articulated into the larger *Sinus* of the *Os temporis* that is also lined with a Cartilage, and is knit strongly thereto by a membranous Ligament. *Its processes.*

This Bone has a cavity within, especially in the fore part toward the Chin, which contains a marrowy juice for its nourishment. *Cavity.*

It has four *Foramina*; of which two are at the roots of the Processes, by which a branch of the fifth pair of Nerves together with a Vein and Artery pass to the Teeth (as shall be shewn further in the next chapter) and two other in its fore- *Holes.*

fore-part by the sides of the Chin, by which two twigs of the said fifth branch pass out again to the lower Lip and its Muscles and Skin.

Surface.

Its superficies is smooth for the greatest part, but in some places there are asperities for the firmer insertion of the Tendons of its Muscles, as was shewn in the description of those Muscles.

The Alveoli of both Jaws.

Both the Jaws have *Alveoli* or Sockets for the Teeth, in number equal with the number of the Teeth. But when in old age the Teeth fall out, the Sockets close together, so that in time there remains no print of them, but the Bone becomes smooth and sharp.

CHAP. VIII.

Of the Teeth.

The Teeth, their name and articulation.

THE Teeth are called in Latine *Dentes*, quasi *Edentes*, from their office of eating. They are fixed in their *Alveoli* three manner of ways: the first and chief is by their articulation with the Jaw-bones, by *gomphosis*; the second is by the Nerve which is inserted into their root, by *synneurosis*; and the last is by the gums which cleave to the outside of their roots, by *syssarcosis*.

Substance.

Their substance is the hardest of all other Bones. That part of them that stands out naked above the Gums is smooth and covered with no *Periosteum*; but that part within the Sockets of the Jaws is rough and invested with a thin Membrane or *Periosteum* that is of exquisite sense.

Cavity and vessels.

The Grinders have a manifest cavity within, (but

(but the *Incisores* and *Canini* but an obscure one) whereinto by the very small holes of their roots they each receive a Capillary artery from the *Carotides*, a Vein from the Jugulars, and a twig of a Nerve from the fifth pair (as abovesaid) which last being expanded through the thin Membrane that invests the said cavity gives it a most acute sense; but the bony substance of it self is wholly insensible. The Vein, Artery and Nerve are united together and clad with a common Membrane when they enter the Jaw, within which they have a proper chanel to run along in under the roots of the Teeth, sending twigs to each as they pass under them.

The rudiments or *principles* of the Teeth are *Principle* bred with the other parts in the Womb, but lie hid for some months within the Jaws and Gums. These principles are partly bony and partly mucous, and both parts are at first included in a membranous and somewhat mucous *folliculus* or case, which in process of time they break through (some sooner, others later) their bony part ascending upwards out of the gums, and their mucous part (hardening by degrees) descending downward into the Jaw so far as there is space for it; the *folliculus* it self turning to a kind of cement, whereby the tooth is fastened to the sides of the *alveolus*.

At what time and in what order they *break Eruption* forth out of the *alveoli*, is known to every Nurse: and omitting therefore to speak of that, I shall onely *growth* note, that the teeth alone, of all the bones in the body, continue to *grow* so long as a Man lives (and they continue in his head) for else would they be soon worn to the stumps by their daily use; and we see that when a Tooth is lost out of either

N n Jaw,

Jaw, (in the oldest people) that which is opposite to it in the other Jaw, will grow longer than the rest, having none to grind against.

Charge.

When Children come to be seven or eight years old, they *change* several of their Teeth; but very rarely, if ever, all. The *Incisores* or Fore-teeth, the *Canini*, or Eye-teeth, and the foremost Double-teeth most change; but the rest of the Double-teeth very few. Now concerning this changing of the Teeth we must now that the old ones do not come out by the roots, but their upper part onely drops off, their root remaining still in the Socket of the Jaw, which (being like feed for the new ones) by degrees grows up above the Gums to supply the place of that which was *fallen off*. Commonly about the twentieth year (or upwards) there spring out two Double-teeth behind the rest, which till then had lain hid in their Sockets. These are called Genuine teeth, or *Dentes sapientiae*, because Men are then come to years of discretion.

Dentes sapientiae.

Number.

As for the *number* of them, commonly there are found sixteen in each Jaw; if there fall out any difference in number as to individual persons, it generally falleth out in the *Molares*.

Sorts.

There are *three* ranks or sorts of Teeth. Those of the *first* rank (or the foremost) are called *Incisores*, Cutters. Most commonly four are found in each Jaw: they have but one root or phang, and so easily fall or are pulled out. These first make way out of the Gums in Children, because the tops of them are sharpest. Those of the *second* rank are called *Canini*, or Dog-teeth, from their length, hardness and sharpness above the rest. In each Jaw there are two, at each side of the Cutters one. They are otherwise called *Eye-teeth*,

teeth, either from an opinion that their roots, (*viz.* of the upper) reach as far as the Eyes, or that the same Nerve that moves the Eye sends a twig to these Teeth; neither of which conceits are true. The roots of these are single as those of the *Incisores*, but they are both sometimes crooked; and if such people in whom they are so, chance to have one of them drawn, they can hardly be pulled out without breaking off a piece of the *Alveolus* in which they are fixt. Those of the third rank are called *Molares*, Grinders; because like Millstones they grind the meat. Most commonly they are twenty in number, five in each side of both Jaws. The two foremost that stand next to the Dog-teeth, are less than the rest having but two knobs at the top, but the three hindmost are larger and have four, being in a manner four-square. The two foremost also have but two roots at most, but the three hindmost commonly three or four. But those of the upper Jaw have for the most part one root more than those which are opposite to them in the lower, or however their roots are larger. The reason whereof may be, first, because they are pendulous, and so are the apter to drop out; and secondly, because the substance of the upper Jaw is not so firm as that of the lower.

The use of the Teeth is principally to chew *Use.* the meat to prepare it for the stomach, that it may the easier concoct it into Chyle. The *Incisores* bite off the morsel, the Dog-teeth break it, and the Grinders make it small; wherefore they are flat in the top, that they may the better receive and keep the meat, and rough, that they may grind it the better. The Teeth contribute also to the formation of the Speech, especially.

cially the Fore-teeth ; for those that have lost them, lisp as we say, and cannot pronounce plainly such syllables as have C. X. &c. in them.

CH A P. IX.

Of the Bone of the Tongue called Os Hyoides.

Oshyoides
its situati-
on and
shape.

TH E Os *hyoides* is seated at the root of the tongue under the lower Jaw, and above the *Larynx*. It is shaped like the Greek vowel *υ*, (whence it is also called Os *ypsiloides*) or like the lower Jaw, being arched before, and extending its two points or horns backward.

Parts.

It is commonly compounded of three Bones. That in the middle is gibbous forwards and hollow inwards ; by its gibbous side it is joined to the *basis* of the Tongue, and into its concave it receives the *Epiglottis*. The other two are lateral, and are called *Cornua*, or Horns. Each of these has a Cartilage adhering to it ; and the middle, two. They are all tied to the adjacent parts, partly by a fleshy, partly by a nervous or membranous substance.

Use.

It serves for the insertion of several of those Muscles that are designed to move the tongue, (described Book 5. chap. 10) and also for keeping the Throat open, that the meat may have passage out of the mouth into the Stomach, and the air into, and out of the Wind-pipe, while we speak and breathe.

C H A P. X.

Of the the Bones of the Neck, viz. the Claviculæ and Vertebrae.

Hitherto of the Bones of the *Head*; we should next proceed to those of the *Trunk* (according to our division of the parts of a *Skeleton*:) but berwixt these lieth the *Neck*, whose bones we must describe in our way.

These are of two sorts, to wit, the *Claviculæ* or Chancel-bones, and the *Vertebrae*.

As to the *Claviculæ*, some reckon them to the *Thorax*, others to the *Shoulder*; but considering their *situation*, they may as fitly be reckoned as pertaining to the *Neck*. They are called *Claviculæ* from their resembling the shape of old-fashioned Keys, which were of the figure of an Itallick *s*; such as *Spigelius* says he has seen belonging to old Houses at *Padua*. They are not so crooked in Women as in Men. Their *substance* is thick and spongie, but more about the heads than about the middle. In *number* they are two, one on each side. Near the *Throat* they are round; but towards the *Shoulder* flattish. They are *joined* to two Bones, to wit, by one end to the *Shoulder-blade*, and by the other to the top of the *Breast-bone*.

Their *use* is to uphold the *Shoulder-blades*, that they should not fall upon the *Breast* together with the *Shoulder-bone*; which falleth out, when there happens a fracture in these bones.

Claviculæ, their situation, figure, substance, number and connexion.

use.

The other Bones of the Neck are the σπόνδυλοι or *Vertebrae*; but before we come particularly to describe these, it will be convenient to premise something concerning all the *Vertebrae* of the Spine in general.

Vertebrae of the whole Spine, their number, substance, parts and holes.

There are reckoned thirty *Vertebrae* of the Spine in all; viz. seven of the Neck, twelve of the Thorax, five of the Loins, and six of os *sacrum*. Each consists of a *Body*, that is convex forwards and somewhat hollow behind, but above and below plain: which body is not of a solid and hard substance, but somewhat fungous and softish. This body has three sorts of *processes* growing out of it toward its hinder side, two transverse, four oblique, and one posterior or acute, which are of an harder substance than it self. There is also a large *proper hole* in its middle, (or rather betwixt it and its processes) for the descent of the spinal marrow: and on its upper and under sides two small lateral *common ones*, that is, common to it self and that next it: for one half of these holes is excavated out of the lower side of the upper *vertebra*, and the other half out of the upper part of the lower; and they serve for the entrance of the blood-vessels into the spine, and for the exit of the Nerves that spring out of the same.

Connexion.

The *Vertebrae* are joined to one another behind by *ginglymus*, forwards by *harmonia*; on the outside by an hard membrane, on the inside by a membranous, hard and strong ligament, reaching from the first *vertebra* of the Neck to the os *sacrum*.

Thusfar of what is *common* to all the *Vertebrae*; As for what is *proper* to those of each of the four regions, that shall be shewn in their particular description.

And

And first for the *Vertebrae* of the Neck, which are in number seven. The Bodies of these are less, but harder than those of the other, which was convenient because they are more moved. They are not of a semicircular shape like the other, but rather four-square, as it were. Their transverse processes have each an hole in them, (which the rest have not,) through which Veins and Arteries pass to the Head. Their posterior processes or spines are forked or cleft into two, except in the first and last *Vertebrae*.

The first or uppermost *Vertebra* is called *Atlas*, because the Head stands upon it, like the globe of the World. It hath no Spine behind (only a little blunt knob) lest the two small Muscles of the Head (called *obliqui inferiores*) springing from the second *Vertebra* and inserted into this, should be hurt, when the Head is bowed forward. *Spigelius* says it has no true body, but rather (instead of it) a tubercle in its fore-side. Both its obliquely ascending and obliquely descending processes have each a sinus in them; the upper receiving the tubercles of the Occiput, and the lower the ascending Processes of the second *Vertebra*. Upon these the Head is moved forwards and backwards. The substance of this *Vertebra* is harder, solidier, but thinner than that of the rest, because it is the least, and yet its cavity is biggest. Within on the fore-side of its great Foramen, it has a semicircular Sinus lined with a Cartilage, whereinto it receiveth the tooth-like Process of the second *Vertebra*.

The second is called *Vertebra dentata*, because out of its upper side between its two ascending Processes, there springs a round, longish and hard Process, in shape like a Tooth, which being

invested with a Cartilage is jointed into the fore-said *Sinus* of the first *Vertebra*, upon which as upon an *Axis* the Head with the said first *vertebra* turns round. And when a luxation happens here, the Neck is said to be broken. This tooth-like Process in that part which enters not into the said *Sinus*, is environed with a Ligament, by which it is knit to the *Occiput*. The hinder Process of this *Vertebra* is cleft into two, as those of the four following are, for the more convenient insertion of the Muscles and Ligaments. Its *transverse* Processes are less than theirs, and have also smaller holes.

The other
five.

The four that lie next under this are in all things like it, save that their *transverse* or lateral Processes are larger, and divided into two as well as the hinder. The seventh is the largest of all. It is liker to the *Vertebrae* of the *Thorax* than of the Neck; for neither its *transverse* nor hinder Processes are cleft like the foregoing, but both are like those of the *Vertebrae* of the *Thorax*, to be described in the next Chapter.

CHAP. XI.

Of the *Vertebrae* of the *Thorax*.

IN the next place we come to the Bones of the *Trunk*, which is divided into the *Thorax* and *Abdomen*.

The Bones of the *Thorax* are the *Vertebrae* of the Back, the *Ribs* and *Breast-bone*.

Vertebrae
of the
Back 12.

First, as for the *Vertebrae*, they are twelve in number,

number, unto which so many Ribs (of a side) answer ; there are seldom thirteen of each, but more seldom eleven. Their *Spines* or *hinder Processes* are not divided into two as those of the Neck, but are solid and simple. The *transverse* are short and blunt, and have each a shallow *Sinus* for the inarticulation of the Ribs; but are not perforated like those of the Neck. The *oblique Processes* (which are four, two ascending, and two descending) serve for the articulation of one *Vertebra* with another. The descending are a little hollowed, and receive the (something protuberant) heads of the ascending Processes of the next *Vertebra* below them, successively. The forepart of their *Body* next to the cavity of the *Thorax* is round, or convex ; and the hinder part lunated, or concave. On each side they have a smooth *sinus* for the reception of the heads of the Ribs; for into these *sinus* they are received as well as into those of the transverse processes. As for their *holes*, they have one large proper one in their middle, which containeth the spinal marrow ; and the one half of two *common* lesser ones, that is, one half on their upper side, and another on their lower, as they join to one another, for the egress of the Nerves, and ingress of the Veins and Arteries, as was shewn before in the general description of the *Vertebræ*.

CHAP. XII.

Of the Ribs.

The Ribs.
Their Sub-
stance.

THE *second* sort of Bones in the *Thorax* are the Ribs, which (as was shewn in the former chapter) are usually *twelve* in number. Their *substance* is partly bony, partly cartilaginous; the first serving for firmness and strength, the second for articulation, and the easier motion of the Breast in respiration. The bony substance towards the *Vertebrae* of the Back is thick and roundish, but towards the *Sternum* flat and thin, and ends in a Cartilage. Within, their bony part is fungous or spongie, whence the Ribs being broken are more readily joined together by a *Callus* than most other Bones. The Cartilages in bigness answer the bigness of the Ribs: for the bigger Ribs have the bigger Cartilages; and on the contrary. The Ribs in the upper side are blunt or broadish, but in the under sharper. In their lower and inner side they have a furrow that runs along them to receive the intercostal vessels, the Veins, Arteries and Nerves.

Seven ve-
ra.

The Ribs are of two sorts, *viz.* *long*, or *short*. The *long* (otherwise called the *true* Ribs) are *seven* in number (being the uppermost:) These are articulated both with the *Vertebrae* and *Sternum*. Their cartilaginous ends or heads are received into shallow *sinus's* in the Breast-bone, and their bony heads being covered with a cartilage are received into the *sinus's* in the bodies of the *Vertebrae*;

brae; and the same heads have each a tubercle (except the two lowest) that being also lined with a cartilage, are articulated into the shallow *sinus*'s of the transverse processes. The articulation into the Breast-bone, is by *Artbrodia*; but that into the *Vertebrae*, by *synarthrosia*; for the motion of the Ribs at that end is very obscure, as being straitly tyed to the *Vertebrae* by ligaments.

Note that the Cartilages of these true Ribs are usually observed to be harder in Women than in Men; which may seem to be for the better sustaining of the weight of their Breasts that lie upon them.

The *short* (otherwise called *Nothæ* or *Spuriæ*, Five no-bastard Ribs) are *five* in number; of which the *four* uppermost having their Cartilages bending upward and cleaving one to another, are joined before to the lower side of the Cartilage of the seventh true Rib; but the last, which is the least, is loose from the rest, and grows sometimes to the Diaphragm, and sometimes to the *Musculus rectus* of the *Abdomen*, as also sometimes does the lowest of the four next above it. Behind they are joined to the *Vertebrae* of the Back, liks as the true Ribs were; only the two lowest, (and sometimes the third) are received only into the bodies of the *Vertebrae*, and not into the transverse processes which here have no *sinus* for their reception.

The *use* of all the Ribs is *first*, to keep the Breast *up* and the upper part of the *Abdomen* distended, that in the former the Heart and Lungs may have free space for their motion; and in the latter, the Stomach and Liver might not be prest upon by the circumjacent parts. *Secondly*, to preserve those parts from external injuries, as from bruises or the

the like. And *lastly*, to sustain the Muscles that serve for respiration, and to yield to or obey their motions ; for if the Breast had been environ'd with one continued Bone, it had not been capable of dilatation in inspiration, nor of contraction in expiration.

CH A P. XIII.

Of the Breast-bone or Sternum.

The Sternum, its substance.

THE *Sternum* (which is the last bone of the *Thorax*) is seated in the middle of the Breast before, serving as a Breast-plate, and having the cartilaginous productions of the true Ribs inarticulated into it. It is of a red fungous substance, and in children almost wholly cartilaginous ; only its uppermost part is in them somewhat more bony than the rest, perhaps because one end of the *Clavicula* is jointed into it. In Infants it consists of seven or eight, but after some years they so coalesce one to another, that in the adult it is compounded but of three, and in aged persons it seemeth but one Bone ; yet it is distinguished by two transverse lines, shewing the former division, which are more conspicuous in the inside than outside.

It consists of three bones and a cartilage.

The *uppermost* Bone is thickest and broadest ; it hath in each side a longish cavity, lined with a Cartilage, to receive the heads of the Clavicles : between these in its middle and upper part is a lunated pit called *Fugulum*. It has also a small *sinus* or dent on the inside, to give way to the Wind-pipe

Wind-pipe descending. The *second* bone is neither so thick nor so broad, yet four times as long. It is joined to the former by an intervening Cartilage, and in each side has five or six *sinus* for the articulation of so many of the true Ribs. The third is least of all, yet it is broader than the second, unto the lower end of which it is joined. What true Ribs were not jointed into the middle Bone, are received by this. To its lower end is annexed the Cartilage called *Mucronata* or *Ensisformis*, Sword-like. This Cartilage is triangular, about an inch long, and on the outside of it there is formed a cavity in the Breast, called *Scrobiculus cordis* or the Heart-pit; and the gnawing pains sometimes felt there, *Cardialgiae*; though those pains are not from any primary affection of the Heart, but of the *upper orifice of the Stomach*, which lies under this Cartilage, and has the name of *Cardia*, from its great consent with the Heart, (as some derive the reason of its name.)

CHAP. XIV.

Of the Vertebrae of the Loins.

THE Bones belonging to the *Abdomen* (which is the *second* or lower part of the *Trunk*) are these; five *Vertebrae* of the Loins, five or six of *Os sacrum*, *Os coccygis* and *Ossa innominata*.

The five *Vertebrae* of the Loins are larger than *Vertebrae* those of the Breast, and the lowest of them are *of the* biggest. They are jointed with the last *Vertebra* *Loins five* of the Back and the first of *Os sacrum*, and with one

one another, by an intervening clammy Cartilage, but more loosely than those of the Back, because the Body bends more upon them. Their *bodies* are larger than those above them; and among themselves the lower the larger: but they are of a very rare and pumice-like substance. Their middle and lateral *holes* are like those of the back, onely the larger half of the lateral is excavated out of the lower *vertebra*, whereas those of the back are formed equally out of both. As for their *Processes*, their *posterior* (or Spines) are shorter and more blunt, but broader and thicker than those of the *Vertebrae* of the *Thorax*, and turn something upwards; but their *lateral* are longer. They also differ in their inarticulation, one with another; for whereas in those of the *Thorax* the upper (*oblique*) Processes were knobby, and the lower hollow, to receive them; in these the contrary is seen; for the upper processes are hollow, and the lower knobby. Onely the last or twelfth *Vertebra* of the *Thorax* has both its ascending and descending oblique Processes hollowed, to receive the heads or knobs of the Processes of the last but one of the *Thorax*, and of the first of the Loins.

CHAP. XV.

Of the Os sacrum, and Os coccygis or Rump-bone.

*Vertebrae
of os sacrum
five
or six.*

TH E *Os sacrum* is the broadest of all the Bones of the Back, and doth sustain all the other *Vertebrae*. On the inside it is smooth and hollow,

hollow, on the outside convex and uneven, being of something a triangular shape. In its upper part on each side it is knit firmly to the *Ossa Iliæ* by an intervening Cartilage. It consists of five or six Bones, plainly distinguishable in Infants, but more obscurely in grown persons. These Bones have the resemblance of (and are usually called) *Vertebræ*, for each of them hath a *Body* and *Processes*, and a large *hole* to receive the *Spinalis medulla*. The Bodies of these differ from those of the other *Vertebræ* in this respect; that whereas in those, the lower part is always bigger, in these it is the less; by which means the uppermost of them is the biggest, and the lowest the least. Their smaller holes which serve for the ingress and egress of vessels differ also from those of the other, in that they are not in their sides, but before and behind; of which those before are much the larger. As for their *Processes*, the *oblique* can hardly be discerned, except in the first. The *transverse* are pretty long, but so united, that all seem but one. The *hinder* or *spines* are like those of the Loins, but less, and still the lower the lesser; insomuch that the lowest hath no Process, but onely a round Protuberance.

To the *Os sacrum* the *Os coccygis* or Rump-bone *Os coccy-* is joined by a Cartilage, somewhat loosely, that it ^{gis} may bend a little backwards in Women in travail for the freer passage of the *Fœtus*, &c. It is compounded of three or four Bones, of which the first hath a small hollownes which receiveth the last *Vertebra* of *Os sacrum*. The rest of its Bones grow each less than other, so that the lowest ends in a cartilaginous point. It is called *Os coccygis*, because in shape it resembleth the Cuckow's bill. Its lower end bends inward, to stay the streight
Gut

Gut and the sphinſter Muſcle, which are tied to it. The Bones of it are ſpongie and ſoft, and have neither Proceſs nor any hollowneſs, for the ſpinal marrow deſcends no further than the bottom of *Os ſacrum*.

CHAP. XVI.

Of the *Oſſa innominata*.

Oſſa innominata, their name.

AT the lower end of the *Abdomen*, by the ſides of the *Os ſacrum*, there ſtand two large bones called by *Galen* *Oſſa innominata* (nameleſs bones) becauſe they had then no proper name impoſed upon them, that he had met with. But *Spigelius* ſays, that *Homer* had long before called them *igſa*, and that they have been generally by later Anatomifts known by that name: (though, by his leave, I think that *Iſchium* is more commonly taken onely for one part of theſe bones called *Coxendix*.)

Situation and connexion.

But be their name what it will, there is one on each ſide the *Os ſacrum*, to which they are joined (through the intervention of a Cartilage) by a moſt ſtrong Ligament, and together with it frame the *Pelvis*, or that cavity in which the Womb, Bladder and part of the Inteftines are contained.

Parts.

In Children each of them plainly appeareth to be framed of three Bones (called *Os Ilium*, *Coxendicis*, and *Pubis*) joined by a Cartilage, untill the ſeventh year; but in Men of ripe age theſe three, the Cartilage being dried and harden'd into a Bone,

Bone, seem but one entire Bone. However for the more exact description of its parts, we must consider it as consisting of *three*.

The *first* is called *Os Ilium*, because under it lieth the small Gut called *Ilium*. This is the uppermost and broadest; in figure, semicircular; arched without, within hollow. Its edge which makes the semicircle is called *Spina*, its arched or outer side *Dorsum*, and its hollow or inner *Costa*. It is joined with the *Os sacrum* by a common membranous and most firm Ligament, with a Cartilage intervening, as abovesaid. 1. Os ili-um.

The *second* is called *Os coxendicis*, (or *Iscbium*) and in English the Hip-bone: though sometimes both these last names are taken in a larger signification, and include all the three. This Bone is the lower and outer part of the *Os innominatum*, and has a large cavity in it (called *Acetabulum coxendicis*) which receives the round head of the Thigh-bone, by the articulation called *Enarthrosis*. The brims of this cavity are tipped as it were with a Cartilage, called its *Supercilium*. Besides this it has another *sinus* in its hinder and inner side, in which the Muscle of the thigh called *Obturator internus* windes about that part of this bone (as a Rope in a pulley) according to *Spigelius*. Its lower end has a large *Appendix* which we rest or bear upon when we sit. 2. Coxendix.

The *third* Bone is called *Os Pubis*, and *Pectinis*, or the Share-bone. This is the lower and inner or fore part of the nameless bone, and even before is joined to its fellow by a Cartilage, which is much thicker, but looser and softer in Women than in Men, for in the former one Bone does usually recede a little from the other in travail, to give way to the 3. Os pubis.

fatus. It has a very large *Foramen* between the *sinus* of the *Coxendix*, and that part whereby it is joined to its fellow, making room for two muscles of the *Thigh*. And above this *foramen* is a *Sinus*, by which the crural Veins and Arteries pass to the *Thighs*.

The Pelvis. Note, that the *Pelvis* that is composed by these three Bones and the *Os sacrum*, is bigger in a Woman than in a Man, to make the larger room for the *Fetus*.

C H A P. XVII.

Of the Scapula or Shoulder-blade.

*The bones
of the
Limbs.*

*The Sca-
pula.
Its sub-
stance, fi-
gure and
connexion.*

HAVING done with the Bones of the *Head* and *Trunk*, there remain to be described the Bones of the *Limbs*, which are the *Legs* and *Arms*. The Bones of the *Arms* are either above the joint of the *Shoulder*, or under.

Above the joint lieth the *Shoulder-blade*, in Greek called *σκαπυλα*, in Latin, *Scapula*. Some reckon this to the *Thorax* because of its situation; as lying upon its upper and back part: but seeing its principal use seems to be for the sustaining and motion of the *Arm*, we have consider'd it as a part thereof. Its substance is for the greatest part thin, but hard and solid. Its outside is a little arched, and its inside hollow. It is somewhat of a triangular figure, and joined to sundry parts by means of the Muscles; which sort of union we called above, *Syssarcosis*. Thus it is joined to the Bone of the *Occiput* by the cucullar Muscles, or the first pair

pair of the *Scapula*; to the *Vertebrae* of the Neck by the same pair, as also by the second and fourth pairs, &c.

It has three *Processes*: of which one is extended along its middle, and is called its Spine; and that end of it that by a shallow *Sinus* receives the *Clavicula*, *Acromium*, its point or tip: Another is lower and less than this, and acute, something like a Crow's Bill, whence it has the name of *Coracoides*; by others it is called *Ancyroides*, Anchor-like: The last is the shortest, called *Cervix* its Neck. In the end of this is a *Sinus* that in its upper part is acute, but in its lower round: this cavity being but shallow of it self has its brims tipt with a Cartilage, which makes it the deeper, into which the head of the Shoulder-bone is received. This articulation is strengthened by very strong Ligaments and Tendons, and is partly hindred from luxation by the top of the second Process.

The Shoulder-blade hath a three-fold use. First, Use. it receiveth the *Os humeri* in the *sinus* of its *Cervix*, by the articulation called *Artbrodia*; as it does the *Clavicula* in the *Sinus* of its *Acromium* by *Synarthrosis*. Secondly, sundry Muscles spring from the Shoulder-blade, which serve for the motion of the *Os humeri*. Thirdly, it defendeth the Back, so far as it reacheth, from external injuries, like a Shield.

C H A P. XVIII.

Of the Os humeri or Shoulder-bone.

THE Bones of the Arm under the joint of the Shoulder are the *Shoulder-bone*, the *Cubit-bones*, and the *Bones of the Hand*.

Os humeri.

The *Shoulder-bone* is but one in each Arm, reaching from the Shoulder to the Elbow. In figure it is round, onely a little flattish behind towards the Elbow; of a hard and solid substance. It is hollow all along like a Pipe, wherein a marrowy substance is contained.

Its upper end.

Its upper end, that is jointed to the *Scapula*, has a great and round head, cover'd with a Cartilage, which is received into the cavity of the *Scapula* by that kind of articulation which is called *Arthrodia*. On the hinder side of this head there stand two rough and uneven Prominences, (which *Spigelius* reckons for another head) into which the Ligaments are inserted. And betwixt these two Prominences there is a round and long chink through which the nervous head of the *Musculus biceps* doth pass.

The lower.

Its lower end is articulated with two Bones, viz. the *Ulna* and *Radius*, by *Ginglymus*, for it both receives them and is received by them, having three Processes and two *Sinus* betwixt them; so that this end resembles a Pulley, whence it is called *Trochlea*. The *Ulna* is jointed with its inmost process, and the *Radius* with the outmost. On its inside, besides the three foregoing, it has a large process or Tubercle from whence those Muscles

Muscles arise that lie on the inside of the Cubit ; and another less on its outside, from which those Muscles spring that lie on the outside. On the hinder side of the *Trochlea* there is one deep large cavity, and on the fore side two small ones, into which the Bones of the Cubit hit, when they are moved backward or forward, and are stopped from being carried further. About the middle of this Bone in the inside, there is an hole through which Vessels pass to the marrowy substance for its nourishment.

CHAP. XIX.

Of the Bones of the Cubit.

THE Bones of the Cubit are two ; to wit, the *Ulna* and *Radius*. Their substance is firm and solid, all but their appendages. They are near of the same length (but the *Ulna* is the longer of the two) and both are hollow within, containing a marrowy substance. They are in some places rough in their superficies, by reason of their lines that are appointed for the rise or insertion of the Muscles.

Two bones
of the Cu-
bit, viz.

The *Ulna* (otherwise called *os cubiti*, and *cubitus*) is larger in its upper end that joints with the *Os humeri*, and grows smaller and smaller towards the Hand, ending in a round Tubercle or small head, with a round *Sinus* in it, (on whose hinder side there grows a small sharp Process, from its shape call'd *Styloides*) receiving one of the bones of the *Carpus*, to which it is knit by

1. *Ulna.*

Ligaments, (a Cartilage intervening.) Its upper end is articulated with the *Os humeri* by *Ginglymus*, to which end it has two Processes, one before and another behind. That before, is received into one of the fore *sinus* of the *os humeri* (mention'd in the former chapter) in bending the Elbow-joint: and the hinder upon stretching out the Arm enters into the hinder cavity of the same bone behind the *Trochlea*, (by which the Cubit is stay'd from further extension than to a streight posture) and is called *Ancon* or *Olecranon*. And at the same end it has also two *Sinus*, the one of which is lateral and external, receiving the Head of the *Radius*; and the other (which is betwixt its two Processes) one of the Processes of the *Os humeri*, which moves in it as a Rope in a Pulley. As it receives the *Radius* in its upper end, so is it received by it in its lower: but in the midst it bends or recedes a little from it, yet is knit to it by a long Ligament.

2. **Radius.** The second Bone is called *Radius*, and lies on the outside of the Cubit. Its upper end is slender, having a round head, one side of which is received by the *Ulna*; but its tip has a round shallow cavity in it, which receives the outer Process of the *Os humeri*, by *Diarthrosis*. Its lower end is thicker and broader, and by a little *Sinus* in its side receives the *Ulna*: and at its extremity it has two other small *Sinus*, for the reception of the little bones of the Wrist.

C H A P. XX.

Of the Bones of the Hand.

THE Hand is divided into three parts: the Wrist, called *Carpus*; the distance between the Wrist and Fingers, called *Metacarpus*; and the Fingers themselves.

Four sorts
of Bones of
the Hand.

The Bones of the *Wrist* are eight in number, placed in two ranks or orders. The upper rank hath four Bones, of which three are so joined together, that they seem but one; (these are articulated to the *Ulna* and *Radius* by *Artbrodia*;) but the fourth being the least of all, is placed a little out of its rank on the outside of the third. The inferior hath also four Bones; they are joined to one another by *Harmania*, but to the Bones of the *Metacarpus* by *synarthrosis*, having some motion though but obscure. They are firmly knit to one another by both a membranous and cartilaginous Ligament; and besides, by another called *annular*, which compassing the Wrist, comprehendeth both them and the Tendons of the Muscles which pass to the Fingers.

1. Eight
of the Car-
pus.

The *Metacarpus* hath four Bones, they are round, and of a solid substance, but hollow within like a Pipe, being full of marrow. They are bigger than those of the Fingers: that which answereth to or sustaineth the Fore-finger is thickest and longest, and the rest grow each shorter and slenderer than the foregoing. Between each two a distance is left for the *Musculi interossei* of the Fingers. Both in their upper and lower end they

2. Four of
the Meta-
carpus.

have an *Appendix*; that at the upper end hath a cavity which receiveth the Bones of the *Carpus*; but that at the lower; a round long head, covered with a Cartilage, which is received by the *Sinus* of the first bone of the *Fingers*, to which the bones of the *Metacarpus* are tied by a transverse Ligament, that lies in the palm of the hand.

s. Fifteen
of the fin-
gers.

The *Fingers* (taking in the Thumb) have fifteen Bones, each three. The first are largest, the second less, and the third the least. On the outside they are round, but on the inside plain and a little hollow, that they may lay the firmer hold upon things. Each has an *appendix* (called by some a *process*) at each end. The *upper Appendices* are round, and those of the first Bones have one round *Sinus* in them whereby they receive the round head of the Bones of the *Metacarpus*: but the upper *Appendices* of the second and third Bones have each two *Sinus*, parted by a small Protuberance. The lower *Appendices* have each two heads divided by a *Sinus*, which are received by the double *Sinus* of the upper *Appendices* of those Bones that join to them: except onely the last or third Bone, which is received by none, but is fenced by a Nail. The second Bone is joined to the first, and the third to the second by *Ginglymus*, and by them the *Fingers* are onely stretched out and contracted. For as for their motion sideways, that depends onely upon the articulation of the first Bones with the Bones of the *Metacarpus*, which is done by *Enarthrosis*, or at least by *Arthrodia*. The jointings of the Thumb answer to these of the *Fingers*, saving that its *upper appendix* is not joined to any Bone of the *Metacarpus* (with which it has no communication)

nication) but immediately to the Wrist; and its lower has but one head, whence the second Bone has but one Sinus in its upper appendix to receive it.

Besides these Bones there are in the inside of the Hand, at the joints of the Fingers, some small Bones called from their figure and bigness *sesamoidea*, like the Grains of *Sesama*, (a sort of Indian Corn so called by *Pliny*.) They resemble in figure the Knee-pan, and seem to serve for the same use; for in strong extensions of the Fingers they strengthen the Tendons of the Muscles upon which they are placed, and hinder the luxation of the joint. Authours differ very much as to their number, because being so small they are seldom all found; but most agree upon the number of 12 to each Hand, placing them thus. At the jointing of the second bone of the Thumb with the first there are two. The second and third joint of the Fore-finger have each one; but its first joint, as also the first of the other three have each two. In Children they are of a cartilaginous substance, but grow bony by degrees, (being invested with a Cartilage) yet not solid but fungous or porous.

4. *Ossa sesamoidea.*

C H A P. XXI.

Of the Thigh-bone, and Patella.

THE Leg (in a large sense) is divided into three parts, the *Thigh*, the *Shank* (or Leg strictly so called) and *Foot*.

The

Os femo-
ris.

The *Thigh* hath but one Bone: but of all others it is the longest and thickest. Before, it is round; but behind, something depressed, and hollow. In the upper part it has a round head; the slender part under this is called its neck, and is pretty long and oblique. The Neck is an *Apophysis* or process to the Bone it self, and the round Head an *Epiphysis* or Appendix to the Neck. This Head is received by the large Cavity or *Acetabulum* of the *Coxendix*, and is detained therein by two strong Ligaments; one that encompasses the brims of the *Acetabulum*, and another that springs out of its bottom, and is inserted into the tip of this round Head or *Appendix*. At the lower end of the Neck, there spring two Prominences from the Bone; which, because the Muscles called *Rotatores* are fastened to them, are called *Trochanteres*. The hinder and lower is the lesser *Trochanter*; and the lateral or uppermost, the bigger. The lower end of the Thigh-bone growing thicker by degrees hath two pretty large Heads, leaving a cavity in the middle that receiveth the *Apophysis* of the *Tibia*, (which is tied therein by a Ligament, as the upper head of this bone is into the *Acetabulum* of the *Coxendix*;) And again these are received by the cavities of the *Tibia*, by a loose *Ginglymus*, both the Heads and Cavities being lined with Cartilages. The forepart of this articulation is called the *Knee*, the hindermost the *Ham*.

Patella.

Upon the *Knee* appeareth a Bone, not joined with any other Bone, called the *Pan*, or *Patella*: it is roundish, about two inches broad, plain without, but convex within and covered with a Cartilage. It is set before the Thigh-bone and the *Tibia*, to strengthen the articulation; for other-
wise

wife the Thigh-bone would be in danger to slip out forward in going down a Hill, or the like. Its substance in Infants new born is soft and cartilaginous, and remains so for many months; but in process of time it becomes bony. It is full of little holes, as all those bones are which pass from cartilages into bones. It is involved by the thick Tendons of the second, third, and fourth Muscles that extend the *Tibia*, (and are implanted into its fore knob) whereby it is fixed in its place.

Behind there are two *Ossa sesamoides*, which adhere to the two beginnings of the *Gastrocnemius externus* (or first Muscle which extends the Foot) to strengthen them.

C H A P. XXII.

Of the Bones of the Leg.

THE Shank (or Leg strictly so called) is composed of two Bones. The greater is called *crūrus Tibia*, the lesser *crūrus Fibula*. These are slightly articulated into one another near each end; but in their middle they recede one from the other, yet so as they are tied together by a strong membranous Ligament that comes between them.

The bones of the Leg two.

The *Tibia* (commonly called *Focile majus*) is partly triangular, by its sharp edge before making what we call the Shin. It has an appendix at each end. That above is bigger, and in its upper part hath one Process, which is received by the

1. *Tibia*.

Sinus

Sinus of the Thigh-bone; and two longish Cavities for the receiving of the two Prominences or Heads of the Thigh-bone, (so that the articulation is by *Ginglymus*) as was said in the foregoing Chapter. About the brims of these *Sinus* there is joined by Ligaments a moveable Cartilage, soft, slippery, and bedewed with an unctuous humour, from its shape called *Cartilago lunata*, the Moon-like Cartilage. It has also a little Head behind (below the foresaid appendix) which enters into the *Sinus* of the upper appendix of the *Fibula*. Its lower appendix is less than the upper, jetting out with a notable Process toward the inside of the Foot, making the *Malleolus internus* or inner Ankle. It has two Cavities; one less in its side, by which it receives the *Fibula*; another greater and lower, divided as it were into two by a small Protuberance in the middle, and lined with a Cartilage, receiving the convex head of the *Talus* that lies under it; as the said Protuberance is received by the shallow *Sinus* in the convex head of the *Talus*: the one being articulated into the other by *Ginglymus*, so that the Foot is moved upwards and downwards (or bended and extended) upon this joint.

2. *Fibula*.

The lesser and outer Bone of the Leg is called *Fibula* (or *Focile minus*;) it is as long as the former, but much slenderer. This has also an appendix at each end: the upper of which reaches not so high as the Knee, nor is it jointed to the Thigh-bone; but in its inner side has a shallow Cavity which receives the little hinder (or lateral) Head of the *Tibia*, that is seated under its upper appendix which is jointed with the Thigh-bone. The lower appendix of the *Fibula* is received by the *Sinus* of the *Tibia*, and extending its

its process to the side of the *Talus*, makes there with the *Malleolus externus* or outer Ankle, which is lower than the inner.

C H A P. XXIII.

Of the Bones of the Tarsus.

OF the Foot (as of the Hand) there are three parts, *Tarsus*, *Metatarsus*, and the Toes.

The *Tarsus* is the distance between the lower end of the two *Focils*, and the beginning of the five long Bones which sustain and are articulated with the Toes. Some call it the *Instep*, but we have in the former book (of the *Muscles*) named it the *Wrist*, supposing that by the *Instep* the *Metatarsus* is rather understood.

It hath seven Bones much differing from one another in bigness and shape.

The first is called *Talus* or *Astragalus* (in English the Ankle or Huckle-bone.) This is of a various figure: Above, it has something a convex head with a shallow *Sinus* in it, articulating with the *Tibia*, as is described in the foregoing Chapter. By the process of the *Tibia* that makes the inner Ankle it is hedged in as it were on the inside, as it is by that of the *Fibula* on the outer. Before, it has a long neck, on which grows a round head that enters into the *Sinus* of *Os naviculare*; upon which jointing the Foot is moved sideways. Its binder side is rough, and in its upper part has a transverse *Sinus* for the receipt of the Ligament of the *Tibia*, and in its lower a little

The Tarsus hath seven bones.
1. Talus.

the descending *Sinus*; by which the Tendons of the Muscles of the foot pass. Below, it has a *Sinus* behind and a Protuberance before, by which it is articulated with the Heel-bone by *Ginglymus*. Betwixt the *Sinus* and Protuberance there is a long and pretty deep Cavity, and over against it another such in the Heel-bone. In these is contained a mucous substance which moistens the cartilaginous Ligaments that join the *Talus* to the Heel-bone, keeping them from drying by continued motion.

2. *Os calcis*.

The second Bone of the *Tarsus* is called *Os calcis* or *Calcaneus*, the Heel-bone, and is the biggest of the seven. It lies under the *Talus*, with which in its upper side it is articulated in the manner just now described. Behind, it receiveth the great Tendon called *Nervus Hæstorius* (or the great cord) composed of the Tendons of the three Muscles that extend the foot. Its fore end is received by the *Os cubiforme*. On its inside it has a large *Sinus*, by which the Tendons and larger Vessels descend to the under side of the Foot; and on its outside it is uneven with several knobs, for the firmer connexion of the Ligaments and Tendons.

3. *Os naviculare*.

The third is called *Os naviculare* or *Cymbiforme*, from its figure. Behind, it receiveth the *Talus* in a large *Sinus*; but before, it is convex, with three flattish smooth heads that are admitted into the very shallow *Sinus* of the three *Ossa cuneiformia* to be described presently.

The remaining four are less than the three already described, and stand all in one rank; the first of them articulates with the Heel-bone, the other three with the *Os naviculare*. There is no Cartilage betwixt them, but they are knit one to another

another on the outside by a cartilaginous Ligament ; and are cover'd both in their hinder and fore-part with a smooth Cartilage where they are jointed with other Bones. The first is called *Cubiforme* or Die-like, having six sides. This is bigger than the other three that follow ; and is seated on the outside of the Foot. In its *fore-side* it is jointed to the fourth and fifth Bone of the *Metatarsus* ; in the *hinder* with the Heel-bone ; and in the *inside*, to the third bone of the *Cuneiformia* : but its other three sides, *viz.* the *outer, upper* and *lower* are jointed to none.

4. Os cubiforme.

The three ensuing are called *Cuneiformia*, or wedge-like Bones ; for above they are thick, and below thinner, so that being jointed, they all of them represent a Vault, being convex on the upper side, but on the under hollow ; in which hollow the Tendons and Muscles are lodged, so that one does not press upon and bruise them in going. The first of these Bones is the greatest, seated in the inside of the Foot ; the second is the least, placed in the middle ; the third is in the mean between both in bigness, and stands next to the *cubiforme*. These three, *behind*, are jointed to the *Os naviculare*, and *before* to the three first Bones of the *Metatarsus*.

5. Three Cuneiformia.

C H A P. XXIV.

Of the rest of the Bones of the Foot.

The bones
of the In-
step five.

THE *Metatarsus*, or *Instep*, hath five Bones : for one is appointed for the sustaining of the great Toe, as well as others for each of the rest ; though in the Hand it is not so, where the Thumb has no Bone in the *Metacarpus* answering to it.

Their substance is very hard and solid, but they are hollow within like so many Pipes, and are longer than the Bones of the back of the Hand. That which stayeth (or is articulated with) the great Toe is thickest, but the longest is that which stayeth the next Toe : the other three grow each shorter than other, but are almost of an equal thickness. Their lower ends being round are inserted into the *Sinus* of the first joints of the Toes : but the upper in their own shallow *Sinus* receive the Bones of the *Tarsus*.

Of the Toes
fourteen.

The Bones of the *Toes* are in number fourteen ; for the great Toe hath onely two, but the rest three. These bones are solid without, and hollow within like those of the *Instep*. Their articulation is altogether like that of the Fingers, so that we shall not need here to describe it over again.

Each Foot has twelve *ossa sesamoidea*, as well as the Hands ; which agreeing both in shape and situation with one another, the Reader may be satisfied concerning these of the Feet in the description of those of the Hand in Chap. 20.

Tab. XVI. representeth the *Skeleton* of an adult body on its fore-side, from *Spigelius*.

- a *The os frontis.*
- b *The os temporis.*
- cc *The two bones of the Nose.*
- dd *The ossa jugalia.*
- ee *The bones of the upper jaw.*
- ff *The lower Jaw.*
- gg *The Teeth in both Jaws.*
- hhhh *The vertebræ of the Neck, Thorax, Loins and os sacrum.*
- ii *The Claviculæ.*
- kk *The Scapulæ.*
- ll *Their first process which articulates with the os humeri.*
- mm *Their second called acromium.*
- nn *Their third called anchoriformis.*
- oo *The os humeri.*
- pp *Its upper and inner head that articulates with the scapula.*
- qq *Its upper and outer head which serves for the implantation of Ligaments.*
- r *The inner head of its lower appendix which receives the ulna.*
- s *The outer head of the same appendix which receives the radius.*
- t u *The two tubercles of the os humeri: t the internal, u the external.*
- x *The ulna.*
- y *The radius.*
- zz *The eight bones of the Carpus.*
- AA *The four bones of the Metacarpus.*
- BB *The four fingers and Thumb, each of which consists of three bones.*

- 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12. *The twelve Ribs.*
- aa *The os Ilium.*
- ββ *The Coxendix.*
- γγ *The os sacrum.*
- δ *The os pubis.*
- εε *The connexion of the os Ilium and Coxendix with the sacrum.*
- ζζ *nn The tubercles of the Coxendix: ζζ The inner, nn the outer.*
- θθ *The Thigh-bones.*
- ηη *The neck of the Thigh-bone.*
- κκ *The upper head of the Thigh-bone that is received into the acetabulum of the Coxendix.*
- λλ μμ *The two Trochanters: λλ the inner, μμ the outer.*
- νν *The two lower heads of the Thigh-bone.*
- ξξ *The patella.*
- οο *The tibia.*
- ππ *The fibula.*
- ςς *The Talus.*
- σσ *os naviculare.*
- ττ *The other bones of the Tarsus.*
- υυ *The five bones of the Metatarsus.*
- φφ *The fourteen bones of the Toes.*

AN

AN
APPENDIX
TO THE
SIXTH BOOK:
DESCRIBING
The CARTILAGES, LIGAMENTS,
and NAILS.

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P p 2

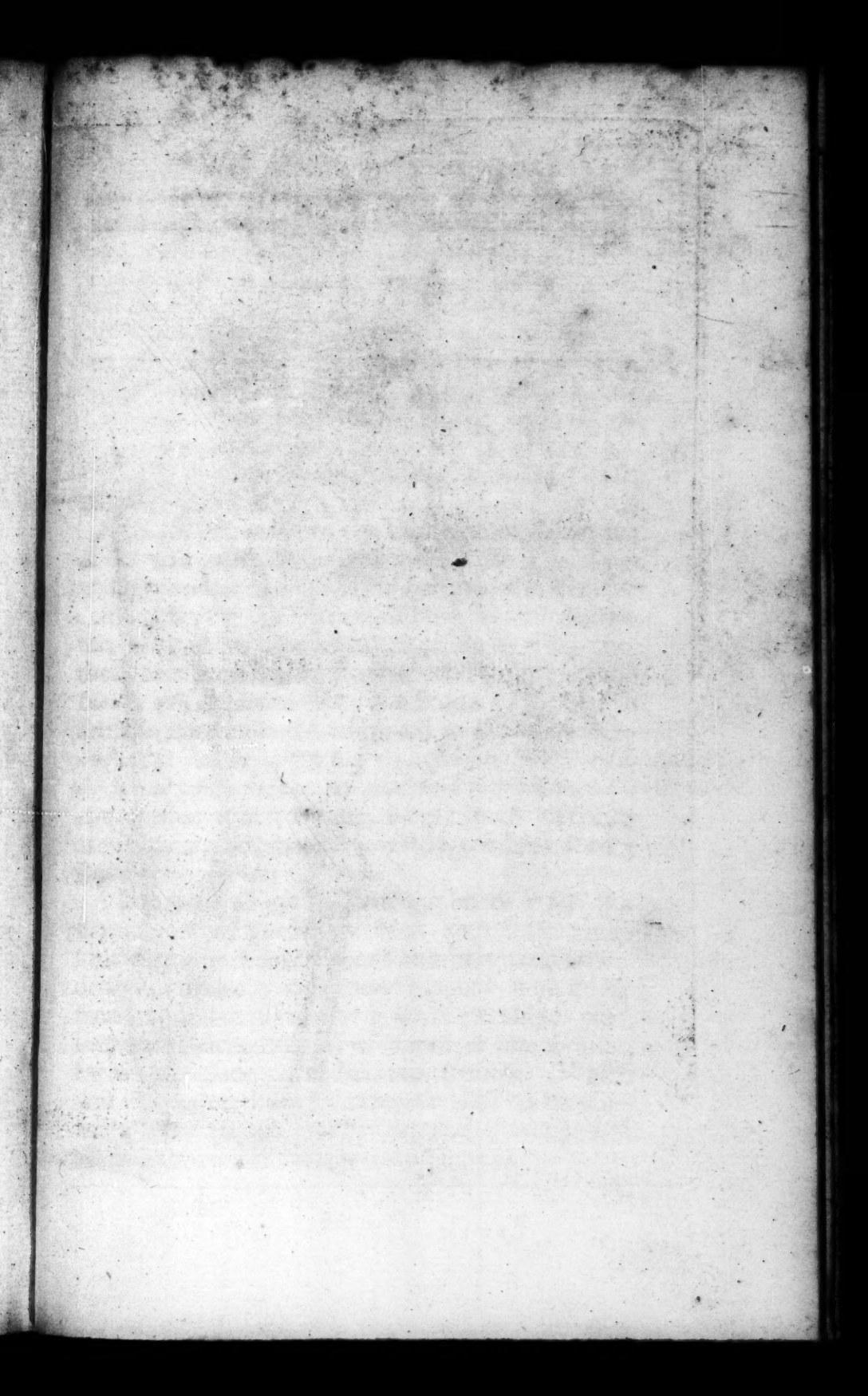
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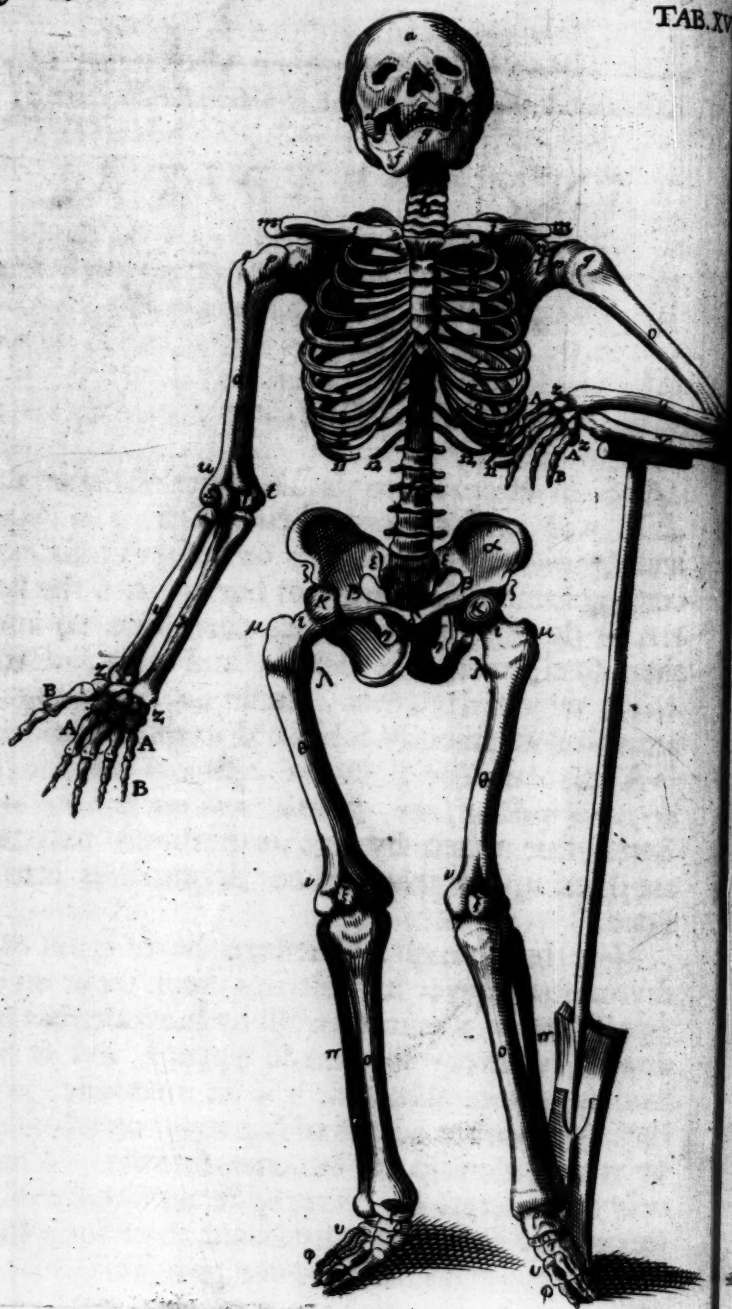
APPENDIX

TO THE
SIXTH BOOK

DESCRIBING

THE CARTILAGES, LIGAMENTS,
AND NAILS





AN APPENDIX, &c.

CHAP. I.

Of a Cartilage.

AS an Appendix to the Doctrine of Bones we will add a word or two of the Cartilages and Ligaments of the Body; because the former come nearest to the nature of bones; and the latter, as they tie several other parts one to another, so especially the Bones: and lastly, of the Nails, which from their similitude of substance are also conveniently subjoined to the Bones.

A Cartilage (or gristle) is a similar part, cold, A Cartilage dry, and void of sense, flexible, and not so hard as a large what. Bone. But when by age its glutinous particles are dried up, it many times degenerates into a Bone.

Note that though a Cartilage be of it self of a dry substance, yet it is always kept moist on its superficies by a mucous or slimy humour that bedews it, whereby it is made slippery and fit for motion. Note also, that it is an insensible part, because it neither admits of Nerves or membranes, by which alone parts become sensible. Which was so ordered by Nature, because otherwise, seeing they are principally seated about the Joints, all motion would have become painfull.

As for the Cartilages of the Eye-brows, Ears, Nose, *Larynx*, &c. we shall not need here particularly to describe them, having done it where we treated of the respective parts; onely we will observe in general, that all the Bones in their articulations one with another, (*viz.* such as admit of manifest motion) are covered or lined with Cartilages, for their easier and glibber motion; and sometimes themselves are the medium by which Bones are joined, which articulation is called *Synchondrosis*, such as that of the *Ossa pubis*; others by tipping as it were the brims of the Cavities of the greater joints, make the *Sinu* deeper; and others lastly constitute parts themselves, as those of the Ears, *Larynx*, &c.

A Cartilage (or gristle) is a similar part, cold, & cartilaginous, and void of sense, flexible, and not so hard as a bone. But when by age its glutinous particles are dried up, it many times degenerates into a bone.

Note that though a Cartilage be of it self of a dry substance, yet it is always kept moist on its superficies by a mucous or slimy humour that becometh dewy, whereby it is made slippery, and fit for motion. Note also, that it is an indestructible part, neither admits of Nerves or membranes, by which alone parts become sensible. Which was so ordered by Nature, because otherwise, being they are principally used in the joints, all motion would have been lost.

CHAP. III.

Of a Ligament.

A Ligament is a similar part, cold and dry, of a middle substance between a Cartilage and a Membrane, appointed for the tying of sundry parts together. *A Ligament what.*

Note, that as it is either harder or softer than is suitable to its proper nature, it acquires the epithets of cartilaginous or membranous respectively; so, that which proceeds out of the top of the Thigh-bone and is inserted into the cavity of the Coxendix, is called a cartilaginous Ligament, for its hardness; and that which environeth the joint of the Shoulder, is called membranous, from its softness. *Their differences.*

Those which tie Bones together are without sense, (for otherwise upon every motion we should have been in pain: but those that knit other parts together, (as those that tie the Liver, Womb, &c. to the neighbouring parts) are sensible. *Why some are insensible.*

Ligaments are found in several parts of the Body. As first, the Head being moved upon the first and second Vertebra of the Neck, there are four Ligaments to strengthen those articulations. Secondly, a common membranous Ligament be- *An enumeration of the principal Ligaments of the Body.* girts the whole articulation of the lower Jaw with the Temple-bone. Thirdly, the Bone at the root of the Tongue has four, by which it is tyed to the neighbouring parts; and the Tongue it self has one strong one on its under-side, (otherwise called

led its *Frænum*) which being too short or running too near its tip, hindreth its motion. Children being so troubled, are said to be Tongue-tyed, and must have it cut. *Fourthly*, both the Bodies and processes of all the *Vertebrae* of the Back are knit together by Ligaments, as also are the Ribs with the *Vertebrae* behind, and with the Breast-bone before. *Fifthly*, sundry are to be seen in the *Abdomen*. The first tieth the *Os ilium* to *Os sacrum*. The second knitteth the *Os sacrum* to the *Coxendix*. The third and fourth knit the Share-bones together, one of them compassing them circularly, and the other, which is membranous, possessing their very *Foramen*, and sustaining the Muscles in that place. As for the Ligaments of the Liver, Bladder, &c. those were discoursed of when we described those parts in B. 1. *Sixthly*, in the Arm these appear. 1. Five tie the *Os humeri* to the Shoulder-blade. 2. The Bones of the Cubit, *Ulna* and *Radius*, are tyed first one to another; secondly, to the Shoulder-bone; and thirdly, to the Wrist by (mostly) membranous Ligaments. 3. There are two sorts of Ligaments at the Wrist; first an annular one which going quite round the Wrist serves to confirm and make steady the Tendons of the Muscles which pass under it to the Fingers. Some make two of it; and then that on the outside is for the Tendons of the extending Muscles; and the other in the inner side, for the Tendons of the contracting Muscles. The other Ligament of the Wrist arising from the lower processes of the *ulna* and *radius*, embraces and straitly ties together the bones of the Wrist, and ends in the upper appendices of the bones of the *Metacarpus*. 4. The bones of the *Metacarpus* are tied one to another

ther and to the bones of the *Carpus* by common Ligaments. 5. The joints of the fingers are also bound by common ligaments: and in the Palm of the hand there lies a transverse ligament that ties the first bone of the fingers to the bones of the *Metacarpus*. Seventhly, In the Leg are these. 1. The Thigh-bone is tied to the *Coxendix* by two Ligaments. 2. The lower end of it is tied to the *Tibia* and *Fibula* by six Ligaments. 3. The *Tibia* is joined to the *Fibula* by three membranous Ligaments, viz. two common and one proper. 4. The *Tibia* and *Fibula* are joined to the *Talus* by three Ligaments; and there are three other for the strengthening of the Tendons, that pass under them, and confirming them in their places. 5. The *Talus* is tied with the other Bones of the *Tarsus* by five Ligaments. 6. The Bones of the Instep and Toes are tied with such Ligaments as those of the Hand are.

CHAP.

other and to the bones of the fingers are also
ligaments. The joints of the fingers are also
bound by common ligaments in the palm of
the hand there lies a transverse ligament that ties
the first bone of the fingers to the bones of the
second, third, fourth, and fifth.
The first bone is tied to the second by two

The Nails.

IN the last place we will say something of the
Nails, which though they are not truly parts
of the Body, yet for their usefulness ought not to
be omitted.

*Their sub-
stance, co-
lour, &c.*

They are of an horny transparent substance,
coming nearest to that of Bones, fasten'd up
on the ends of the Fingers and Toes for their de-
fence. They are endued with no sense, nor is
that colour which they appear to be of upon the
Fingers, owing to their proper substance, but to
the colour of the parts that lie under them;
whence they sometimes look ruddy, sometimes
pale, blue or yellow, and thereby give some inti-
mation of the state of the Body. For thus in a
swoon they look pale, because little blood is then
driven into the flesh that lies under them: in a
Jaundice they look yellow from the bile that is
mixed with the blood, &c. They grow very
firmly to the subjacent Flesh; and to fasten them
the better, they are tied about their root with a
Ligament, and on their sides the Skin closes them
in. The parts that lie under them are very sensi-
ble, for there are several twigs of Nerves and ten-
dons of Muscles that run to the very Fingers
ends; so that upon handling any hard or rugged
thing we should have been continually in pain,
if these so sensible parts had not been thus defend-
ed by the Nails. Which defence seems to be
their principal use; for their use to scratch with-
all

all is but secondary and less considerable.

They may in some sense be reputed *parts* of the *Body*, so as that it would not be perfect and in-^{*In what respect they are*} tire without them : but that is but an *improper* ^{*parts of the Body.*} notion of a part. For if they were *properly* parts, they should live by the common life of the *Body* ; but that they do not, seeing *they* as well as the *hair* continue to grow after a Man is dead : and their growth seems merely to be by apposition of new particles to their roots, which drive on successively those before them ; as we may see when there is a black or white speck on any of them , for it still goes forward together with the Nail , till it arrive at the Fingersend beyond the Flesh.

F I N I S.

all is but a vanity, and for consideration
They may in some (the body) of the world
body, to say that it would not be worth and in
one without them: but that is but an
reason of a part. For if they were properly parts
they should live by the common life of the body
but that they do not, feeling as well as the
As continue to grow since a Man is born, and
that growth seems merely to be by apposition of
new particles to their roots, which drive on the
causively those before them; as we may see when
there is a black or white speck on any of them,
for it will go forward together with the rest,
and a minute in the finger end beyond the joint

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